CTEIP

Central Test & Evaluation Investment Program




2001 Annual Report

Executive Summary

Past Annual Reports outlined the effects of the overall decline in test investments that was so evident in the 1990s. These effects, which included aging and obsolescent facilities and a shrinking workforce, posed a serious threat to our ability to adequately test and field new defense systems. There are signs, however, that while this trend has not been reversed, it may be slowing. The case for better support for test and evaluation (T&E) is being made more cogent and compelling, and Congress has responded with small increases to the requested amounts in the T&E funding lines. While such developments are encouraging, legitimate concerns remain over our ability to meet future test requirements. A clear divergence between an increasing test workload and decreasing test resources remains. Operating and investment funding for the Major Range and Test Facility Base is still on the decline, and our workforce is continuing to shrink. In addition, demand for reallocation of critical test resources such as frequency spectrum not only continues, it is on the increase. All of this is occurring during a time of unprecedented advances in technology, which further strains our present test capabilities to the limit. Under these conditions, how can we expect to meet the challenges of the future? Directly addressing many of the aspects of this problem, the CTEIP provides a part of the answer. By focusing on obtaining the best return on test investments and making the best use of scarce test assets, the CTEIP provides a coordinated process for funding T&E investments that leverage Service investments and encourage joint development and use of new test capabilities. The objectives of the program are designed to both preserve and enhance our test capabilities and to proactively address many of the problems presented by dwindling assets and growing requirements. These objectives are to:

- Support joint test projects that apply state-of-the-art technologies to correct deficiencies in DoD T&E capabilities and improve the efficiency of the test process;
- Maximize efficient inter-Service use of test assets by improving interoperability and interconectivity among test centers, ranges, and facilities;
- Establish and maintain a program to develop T&E technology to investigate, develop, and produce prototypes of advanced technologies for application to T&E that reduce resource requirements such as frequency spectrum, manpower requirements, operating expenses, maintenance requirements, and cost;
- Achieve interoperability across the Services in test instrumentation, targets, and threat simulators;
- Develop, validate, and integrate modeling and simulation with open-air testing to provide timely, accurate, and cost-effective results;
- Exploit capabilities in mobile test instrumentation as an alternative to fixed facilities where economically and technically feasible; and
- Provide resources to respond to critical near-term shortfalls in operational test capabilities.

CTEIP Selection Process

CTEIP projects are selected by a process that ensures the active participation of all concerned parties and fosters a robust competition for limited funds. Through a Needs and Solutions process, joint CTEIP projects are selected from candidates submitted from the Services and Defense Agencies or developed from the Office of the Secretary of Defense (OSD) initiatives. Candidates that originate from the Services are initially reviewed and evaluated at various levels of the Services' T&E Executive Agent (T&E EA) structure and are then forwarded to OSD for consideration. Those candidates that originate from the Defense Agencies receive similar scrutiny and are examined for possible consolidation with those of the Services. Recent improvements to this process have focused on increasing the overall corporate coordination by stressing cooperative efforts between OSD and the T&E EA.

CTEIP Project Categories

The CTEIP consists of three types of projects: Joint Improvement and Modernization (JIM), subprojects within Resource Enhancement Project (REP), and subprojects within the Test Technology Development and Demonstration (TTD&D) project.

JIM projects address critically needed T&E investments in major functional areas of T&E and comprise the majority of the projects conducted under the CTEIP. Generally the largest of the CTEIP projects in terms of funding and scope, JIM projects must meet stringent criteria such as multi-Service or joint application and acceptable risk and cost. Projects include automated data collection, processing, display, and archiving; smart munitions testing; simulation and endgame measurement; applications of advanced materials; and advanced sensors and space systems. A special emphasis within this category is placed on the potential electronic linking of test ranges and centers to improve test realism and increase test efficiencies. Added emphasis has also recently been placed on developing more efficient means to use radio frequency spectrum for test and evaluation.

The REP supports subprojects that are tailored to resolve near-term shortfalls in operational test capability through immediate funding and development. REP funding is appropriate when the timeframe between the identification of a test need and critical test dates does not allow enough time in the budget cycle to fund the required capability. All subprojects approved for REP funding are validated and documented in approved operational test plans. The requirements are traceable to a specific weapons system's Milestone III decision and must meet a critical operational test date within two years.

Subprojects conducted under the TTD&D project contribute to innovative test techniques and capabilities and develop test technologies for wider applications. Prime consideration is given to projects that show the potential for high payback in terms of better data for decision making, increased test efficiencies, greater safety, labor savings, and reduced maintenance costs.

Benefits

The CTEIP provides an essential forum for participants, often with disparate interests and objectives, to make corporate decisions on test investments to best develop and improve test capabilities. The most compelling reason for the CTEIP's successes is that these investment decisions are backed with funding that is in hand, available now, and specifically designated for use in improving test technology and infrastructure. Uniquely postured as a significant contributor to meeting the test challenges of the future, the CTEIP continues to be a sterling example of a joint, multi-Service process whose benefits are demonstrated, tangible, and in place on the nation's ranges and test centers.

CTEIP Success Stories

Joint Improvement and Modernization (JIM)

Advanced Range Telemetry (ARTM)

The ATRM program has conducted a series of ground and flight tests to prove the Feher Quadrature Phase Shift Keying -”B” spectrum efficient modulation technique doubles the amount of transmitted telemetry data as compared to existing capabilities. Products from the ARTM program including transmitters and demodulators are expected to be commercially available in the Spring of 2001. The F-22 program has determined that if they use the ARTM products they will be able to conduct tests in the limited portion of the S-band thereby avoiding the cost associated with rewiring their test aircraft to use L-Band for telemetry.

Airborne Separation Video System (ASVS)

The first phase of this project, the development of a digital imaging system to provide a ruggedized equivalent (512x512) for 16mm film camera applications, saw successful completion of all design, development, and testing efforts in FY00. As an airborne imaging system, ASV has successfully proven its ability to replace the use of high-speed film on several tri-Service aircraft platforms including F/A-18 E/F and F-16. Currently, ASV is supplementing existing film systems on board the F/A-18 E/F, however, as the reliability of ASV is substantiated, it is anticipated that the F/A-18 program will transition completely to digital technology. When fully implemented, ASV has no recurring costs other than the negligible expenses associated with the storage of the data files. Digital Implementation will reduce recurring costs by up to $15K per test flight. Accordingly, the time and manpower associated with data reduction will be reduced by up to 95%. Based solely on recurring costs, ASV airborne implementation will show complete payback of initial investment in as few as two years. The F/A-18 Hornet platform has recently exploited the previewing and dynamic in-air-control capabilities of the ASV system to capture images of test events such as MK-82, MK-84, Joint Direct Attack Munition, and Joint Standoff Weapon bomb drops as well as Advanced Short Range Air-to-Air Missile, Advanced Medium Range Air-to-Air Missile, and AIM-9X next generation sidewinder launches. The second phase of this project, the development of a digital imaging system to provide a ruggedized equivalent for 35mm film camera applications, saw successful completion of all design and development in FY00 and will complete testing in first quarter FY01. The Long Term Test Capabilities Camera (1280x1024) successfully transitioned from Charge Coupled Device (CCD) sensor technology to Complementary Metal-Oxide Semiconductors (CMOS). The use of CMOS technology lowers the final cost of the sensor and, ultimately, the end product, while providing superior image quality. The recent successes of ASV have attracted several new customers from the tri-Service community. Additionally, there has been a significant interest by foreign military users as well. The system flies on a regular basis and is proving to be a mature, stable, and reliable system. Several ground tests are planned for the first quarter of FY01 to assess the ground-based capabilities of the LTTC. It is anticipated that the system will provide to be as valuable to ground-based test, as it has to airborne application.

Foundation Initiative 2010 (FI 2010)

The Foundation Initiative 2010 (FI 2010) project is developing a common architecture called the Test and Training Enabling Architecture (TENA) and a core set of tools to enable cost-effective interoperability among ranges, facilities, and simulations to support testing weapon systems and training warfighters. In June of 2000, the FI 2010 project supported the Joint Strike Fighter (JSF) program in their Virtual Strike Warfare Environment 7 test event. For this test mission, data definitions for strike warfare missions were established, and interfaces for the JSF cockpit simulators, the scenario generator, and the threat simulators were built to integrate them into a cohesive virtual test environment. Furthermore, a refined integration process was used that significantly reduced the test configuration and integration time to a period of months vice a period of two years for comparable test events of similar magnitude. Using the Defense Research and Engineering Network, the distributed test event linked three major DoD facilities together, specifically the Air Combat Environment Test and Evaluation Facility located at Patuxent River NAS, MD, the Simulation and Analysis Facility located at Wright-Patterson AFB, OH, and the Avionics Test Integration Complex at Edwards AFB, CA. To establish the common architecture at the major DoD test and training ranges, FI 2010 project is coordinating with the Range Commanders Council so that TENA standards and protocols are reviewed and adopted across the range community.

Hardened Subminiature Telemetry and Sensor System (HSTSS)

The HSTSS Integrated Product Team (IPT) embraced an "open architecture" philosophy, resulting in a modular, interoperable system, capable of meeting the requirements of many different munition development programs. While still in development, HSTSS products are already actively supporting testing applications. HSTSS transmitters, delay/repeater integrated circuits and batteries supported in-bore measurements taken at Aberdeen Proving Ground (APG) Aberdeen Test Center (ATC) in CY00, developed to support 105mm electro-thermal cannon tests. Acquired ballistics data (while still in the gun bore) allows the developer to optimize designs and isolate faults that were previously undeterminable. HSTSS developed batteries and encoders were configured and supported MLRS stockpile tests, providing needed (previously unavailable) fuze performance data. The MLRS testing took place in June 2000, and additional flights are scheduled for FY01. HSTSS developed components allow acquisition of data that was previously unattainable. This additional test data will allow a reduction of required shots fired, saving money in the process. HSTSS is currently being configured for use by PM-TMAS on Tank Extended Range Munition-Kinetic Energy (TERM-KE) developmental aeroballistic and internal electronics tests, scheduled to take place in FY01. Additionally, HSTSS is expected to be embedded in the tactical round to allow training and future testing without redesign. This is a logical plan to reduce lifecycle costs. HSTSS developed components are designed to reduce instrumentation component costs, and are doing so. For example, the HSTSS transmitter is estimated to achieve a cost reduction of 75% compared to the existing industry standard commercial transmitter. Developed with a modular approach, HSTSS can be updated with improvements in technology using a "modernization through spares" approach, thus avoiding obsolescence. The HSTSS IPT has been actively working with Government/Contractor IPTs to help integrate HSTSS products into the developmental system, as well as planning for migration towards their tactical needs. To formalize this planning, the HSTSS IPT has signed Memorandum of Agreements with Project Manager for Armaments and Project Manager for Tank and Medium Armament Systems. HSTSS is actively working with NASA, Kennedy Space Center, with the intent of using HSTSS-developed products for telemetry upgrades and payload services on the Space Shuttle. This can also extend to ground support activities during missile and Shuttle launches.

Holloman High Speed Test Track Upgrade (HHSTT)

The Holloman High Speed Test Track (HHSTT) Upgrade Program, which will be complete in FY02, has already begun to yield benefits for hypersonic test customers. Improvements in structural dynamics modeling and simulation resulted in a greater understanding of the severe dynamic conditions experienced by test articles. Additionally, improved equipment and techniques to survey and align the HHSTT rails reduced the dynamic loading on test articles, allowing higher fidelity testing. These improvements led to superior test vehicle designs that demonstrated 100% reliability in FY99 and FY00 on the Navy's SM-2 and SM-3 lethality test programs at test velocities up to 7200 feet per second.

Three of the Super Road Runner (SRR) rocket motors have been successfully static fired with consistent, predicted results. In addition, the Test Track has successfully run the first HHSTT Upgrade Program mission using the newly-designed narrow gage sled, collecting more telemetry data than anticipated. The data directly correlated with the data generated through structural dynamics modeling and simulation, thus providing proof that the modeling techniques are accurate. In addition, photographs revealed that the aerodynamics of the new narrow gage sled, at both low and high mach speeds, reacted as designed and predicted. These successes are the foundation to the project's development planning and demonstrate that the development risk has been significantly reduced. They begin to prove that the integration of the narrow gage sled and the SRR motor will be capable of delivering payloads at greater speeds with greater reliability.

Translated GPS Range System (TGRS)

The TGRS project was established to provide engineering, development, and initial test sets of a new generation of time-space-position information (TSPI) instrumentation TGRS consists of an airborne Digital Global Positioning System (GPS) Translator (DGT) and a ground-based GPS Translator Processor (GTP). The DGT at $30K/unit replaces the analog Ballistic Missile Translator (BMT) that cost $125K/unit. The GTP replaces the Translator Processing System (TPS) and tracks both analog and digital translators. The GTP at $300K/unit replaces the TPS at $1.2M/unit. The DGT provides a compact and accurate range capability for strategic and tactical missiles and spacecraft vehicles. The GTP miniaturizes the past processing system, incorporates an all-satellites-in-view capability, reduces data latency, and tracks vehicles with dynamics of up to 75g. The GTP provides TSPI data necessary to perform post flight analysis. Such analyses evaluate interceptor and target performance, including flight test lethality and miss distance within two to three feet accuracy. The equipment provides range safety and weapon system testers with accurate real-time position data during all phases of missile launch and flight. In 1999, The TGRS successfully supported the following the National Missile Defense's (NMD) Radar Credible Target Mission and NMD's Integrated Flight Test (IFT) number three. In 2000, the TGRS supported the NMD's IFT-4 and 5 missions and an Eastern Range Trident Missile test mission.

Transportable Range Augmentation and Control System (TRACS)

The Transportable Range Augmentation and Control System (TRACS) project, which provides a suite of easily transportable instrumentation can be developed and deployed to any MRTFB to provide additional mission control capability required during surge workload, successfully reached its Initial Operating Capability (IOC) in October 1999. In this configuration it is already supporting Ballistic Missile Defense acquisition programs at White Sands Missile Range (WSMR). Even before achieving IOC, the different subsystems of TRACS were used, independently of each other, to support numerous developmental missile tests at WSMR including tests of Theater High Altitude Area Defense (THAAD), Patriot Advanced Capability (PAC-3), Patriot, Army Tactical Missile System, SM-2 and Black-Brant. The IOC in system configuration has already been deployed three times to a remote site, Fort Wingate, NM, to support tests at WSMR of the PAC-3 missile defense program (the target missiles are launched from this remote site). This support has avoided the cost of $15 Million for the project and for WSMR to develop this required capability. During the second quarter of FY01, the TRACS is scheduled for another PAC-3 WSMR test and to support testing of the Air Force's Advanced Medium Range Air-to-Air Missile Foreign Military Sales program in Iwo Jima, Japan. TRACS will result in additional cost avoidance for DoD when it is deployed to Pacific Missile Range Facility (PMRF) during FY02 and FY03 to support the Navy Area Theater Ballistic Missile Defense program. TRACS equipment will be housed on a shipboard platform during these tests. The TRACS equipment has performed flawlessly for all tests it has supported exceeding the requirements of the system specification for setup time, performance, and reliability.

CTEIP Success Stories

Resource Enhancement Project (REP)

Advanced Missile Instrumentation Package (AMIP)

AMIP provides the Army with a new capability to fire multiple missiles over water or land, track multiple missiles fired concurrently, and track the missiles to an accuracy of at least +/- 3 feet over land and +/- 6 feet over water at a range of up to 40,000 feet. AMIP provides adequate missile seeker evaluation data, missile attitude data, and TSPI within the timeframe and firing scenarios required by the Suite of Integrated Infrared Countermeasures (SIIRCM) / Common Missile Warning System (CMWS) programs.

AMIP achieved its initial operating capability in September 1999 and successfully supported the Tactical Aircraft Directed Infrared Countermeasures Advanced Technology Demonstration testing in that year, Advanced Threat Infrared Countermeasures final operating testing in FY00, and is currently scheduled to support SIIRCM/CMWS initial operating testing in FY01.

Laser Observation Test and Evaluation Capability (LOTEC)

LOTEC provides the USMC with a capability to verify the location and pulse repetition frequency of the non-visible laser from the Army's Lightweight Laser Designator Rangefinder (LLDR) and the Marine Corps' Tactical Laser Designator Handoff System (TLDHS) and correlate target data, as well as the data transmitted to the Fire Support Control Center.

LOTEC also provides the capability to gather data for correlation of system accuracy that is necessary for a safe environment when using laser guided munitions during operational testing of the LLDR and TLDHS and allows for positive confirmation that the laser is pointing at the location as the visual aim point from the thermal imagery system. LOTEC will be supporting the initial operational test and evaluation of the USMC portion of TLDHS in March 2001.

Realistic Operational Communication Scenarios (ROCS)

ROCS is a simulation and instrumentation tool that provides a unique tactical USMC data communications infrastructure loading for the Marine Air-to-Ground Task Force commanders integrated tactical data network (TDN) and associate tactical data systems. ROCS enables USMC to address interoperability, interface capabilities, and performance of the TDN.

ROCS supported the combined Operational Assessment (OA) of Enhanced Position Location Reporting System, Data Automated Communications Terminal , and the Combat Operations Center in September 1999. ROCS also supported theY2K Operational Evaluations during FY99 and the OA of Joint Enhanced Core Communications System in April 2000. The information produced from using ROCS during these tests proved highly useful in the development of these systems and the Marine Corps data network.

Reconfigurable Electro-Optical and Magnetic Expendable Target (REMET)

REMET provides the USMC with a full-scale, validated, surrogate tank target that replicates a Russian T-80 Main Battle Tank in its physical profile and magnetic signature. REMET can be positioned in areas of the test ranges that were unattainable with other remote controlled targets.

REMET achieved initial operating capability in January 2000 and was successful in supporting the Predator initial operating testing. Test shots were conducted at Ft. Greeley, AK, Ft. Bragg, NC, and China Lake/Camp Pendleton, CA, and REMET exceeded expectations in both mobility and durability. Compared to actual threat targets, REMET required limited maintenance and was able to withstand multiple shots before being completely destroyed. Each REMET costs $15K and its usage avoids the $2M acquisition cost of an actual M-8 tank. Additional cost savings were also attained in engine usage, shipping costs, and repair.

Suite of Integrated Infrared Countermeasures / Common Missile Warning System Test Instrumentation Package (SIIRCM / CMWS TIP)

SIIRCM/CMWS/TIP provides a multi-service suite of hardware, software, and documentation that provides instrumentation, data collection and data reduction for ground and flight testing of the Advanced Tactical Infrared Countermeasures (ATIRCM)/CMWS system. The SIIRCM/CMWS TIP supports digital simulations, hardware-in-the-loop simulations, captive seeker tests, sled tests, false alarm tests, aerial cable tests, drone tests, and systems integration lab tests. The SIIRCM/CMWS TIP components are fully transportable and do not depend on installation-level infrastructure to function.

The SIIRCM/CMWS TIP initially became operable in March 2000. It is currently integrated on the AH-60 and data has been gathered successfully during contractor flight testing and contractor sled testing conducted throughout FY00 at Holloman, AFB. The TIP will also be used by all Services as part of the Combined Developmental Test and Evaluation and Operational Test and Evaluation and will continue to be heavily used in FY01 and FY02. SIIRCM/CMWS TIP is scheduled to support Advanced Threat Infrared Countermeasures final operating testing and Tactical Aircraft Directed Infrared Countermeasures initial operating testing in FY01 and SIIRCM MH-60K and SIIRCM EH-60K initial operating testing in FY01 and FY02.

CTEIP Success Stories

Test Technology Development and Demonstration (TTD&D)

Applied Computational Fluid Dynamics (ACFD)

Over the past several years, the ACFD subproject has organized a tri-Service effort that developed analysis tools to effectively use computational fluid dynamics (CFD) for store certification analysis. The effort focused on three main thrust areas. The first thrust area, which was led by the Army, provided advanced rotorcraft models to include downwash, crosswind, and ground effects. The Navy spearheaded the second thrust area, which developed tools to evaluate the external flowfield regime. The third thrust area, led by the Air Force, developed, evaluated and inserted computational tools in the internal bay regime. ACFD computational tools were used as part of a US Air Force and Royal Australian Air Force (RAAF) partnership that evaluated the advance store separation hardware and small smart bombs in an internal cavity environment. ACFD played an important role in assessing the safety-of-flight for store separation from a weapons bay. The RAAF F-111 flight test data will be used to further validate the ACFD for simulating store separations from internal weapon bays and will benefit such programs such as the F-22, Joint Strike Force, B-2, and Unmanned Combat Air Vehicle. The Army employed ACFD with Hydra Code development, which combined vorticity-embedding with a Navier-Stokes CFD flow solver for prediction of rotor wakes. The Army modeled ship-helicopter wake interactions that will have a significant impact on future ship-helicopter landing operations. The Army continued to use ACFD to support the RAH-66 development, including weapons bay flow simulation. The Navy also employed ACFD to analyze the impact of a Targeting Forward Looking Infrared System installation on the F-18C/D, which resulted in significant time and costs savings.

Multi-Band Antennas for Telemetry (MUBATS)

The MUBAT subproject is developing multiple band antennas for air-launched munition testing that supports telemetry, Global Positioning System (GPS), and flight termination needs. In its first year of execution, the subproject fabricated and ground tested a wide-look, quadrafilar helix GPS L1/L2 antenna, as well as two S-band/GPS L1 dual band antennas. During the past year, major strides were undertaken to develop a smaller multi-band antenna for use on tactical configurations. The subproject investigated the savings in space that would result from dispensing with the "soda can" design of placing separate GPS and telemetry antennas adjacent to each other. A Hybrid GPS approach was used in which the GPS and telemetry antennas were located on the same substrate. A filter/limiter/amplifier network was used to eliminate crosstalk and interference between the antennas. After the completion of an analysis and simulation, this design was used in fabricating a prototype antenna. Initial results are promising, and further testing will be carried out in FY01.

Next Generation Instrumentation Bus (NexGenBus)

The NexGenBus subproject has been in the forefront in the development of network-based test instrumentation systems. The subproject has established a commercial-off-the-shelf (COTS)-based instrumentation bus, which operates at 100 times the speed of current busses (1 Gbps vs. 10 Mbps) and will be used as a standard for test instrumentation systems of the future. NexGenBus researched and evaluated over 31 communication bus standards before selecting the Fibre Channel standard as the most suitable standard for leveraging purposes. Fibre Channel is an American National Standards Institute (ANSI) standard that can use both copper wires and fiber optic cables. In the past, a major drawback in using COTS equipment for military testing has been finding units rugged enough to withstand the test and operational environment. Fibre Channel has proven it's ruggedness, having already been used in avionics upgrade programs.

NexGenBus has been working with the Range Commanders Council (RCC) Telemetry Group to establish an instrumentation bus standard. An interoperability profile was written that proposed the adaptation of Fibre Channel standards for the instrumentation community in a way that will promote interoperability without compromising the ability to leverage the commercial market. The NexGenBus standard should be published in the RCC Telemetry Standards document (IRIG 106) in FY01.

Joint Improvement and Modernization Projects

- **Advanced Multiple Object Acquisition System**
- **Advanced Range Telemetry**
- **Airborne Icing Tanker**
- **Big Crow Electronics Warfare Enhancement Project**
- **Decade Radiation Test Facility Enhancement**
- **Electromagnetic Environmental Effects Generating System**
- **Electromagnetic Transient Test and Evaluation Facility**
- **Foundation Initiative 2010**
- **Hardened Subminiature Telemetry & Sensor System**
- **Holloman High Speed Test Track Upgrade**
- **Joint Advanced Missile Instrumentation**
- **Joint Installed Systems Test Facility Projects**
- **Joint Modeling and Simulation System**
- **Land and Sea Vulnerability Test Capability**
- **Multi-Service Target Control System**
- **Roadway Simulator**
- **Threat Simulator Development Project**
- **Transportable Range Augmentation and Control System**
- **Tri-Service Signature Measurement and Database Systems**

NEW STARTS

- **Advanced Instrumentation Data and Control System**
- **Digital Video Laboratory**
- **Global Positioning System Signal Validation**
- **Joint Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance**
- **Magdalena Ridge Observatory**
- **Silent Sentry**

The Joint Improvement and Modernization (JIM) projects are those CTEIP projects which consist of investments to improve the test capabilities base. The JIM projects represent critically needed test and evaluation investments in the major functional areas of test mission command, control, communications, and instrumentation; electronic warfare systems; threat and computational simulation test and evaluation; space system test and evaluation; weapons effects test capabilities; targets; and physical and environmental test capabilities. The investments are made in the development of advanced technologies needed to test increasingly complex and sophisticated systems. Such technologies include automated data collection, processing, display, and archiving; smart munitions testing; simulation and end-game measurement; advanced materials applications; test design; and advanced sensors and space systems.

For further information contact Mr. Derrick Hinton, CTEIP Program Element Manager at (703) 578-8222, e-mail dhinton@dote.osd.mil.

Advanced Multiple Object Acquisition System (AMOAS)

The AMOAS project will develop the next generation multi-target acquisition and tracking system necessary to meet test and evaluation requirements for simultaneous precision tracking of large numbers of low radar cross section (RCS), high velocity targets, decoys, and debris. At completion, the project will employ sensor fusion techniques that combine data from separate sensors, such as optical and radar instrumentation, in order to provide the required time/space/position information and track file data of the weapon system at any given point during a test.

Requirement

The baseline requirement for the AMOAS project is to provide a very wide field-of-view, high resolution, multi-object acquisition and tracking instrumentation system that can track smaller targets at extended ranges with precision and accuracy that exceeds even the most capable current systems. The AMOAS platform will also have the ability to analyze and reduce test event data internally and provide this data very quickly in a distributed environment. The need for AMOAS exists in that current and future testing of weapons systems will require:

- Tracking of higher numbers of targets (> 100 separate targets);
- Tracking of Low Observable targets (low RCS);
- Tracking of targets at extreme distances (> 250 km); and
- Highly versatile, highly robust real-time and post-flight reporting capabilities.

Using state-of-the-art fusion engines, the system will be able to integrate with existing ground-based acquisition tracking platforms. Its architecture will be both High Level Architecture and Test and Training Enabling Architecture compliant.

Description

The design approach for AMOAS is to build upon existing methods of machine vision alerting and cueing techniques and adapt them to provide real-time optimized tracking resources based on pre-programmed and event initiated scenarios. The AMOAS will comprise the following subsystems:

- Command, Control, Communications and Data Reduction Van (C3DRV);
- Active Phased Array Radar (APAR);
- Air Space Surveillance Radar (ASR); and
- Distributed Optical Imagery (DOI).

AMOAS will be of a modular and highly mobile design to provide support at any DoD test and exercise/training range, technology demonstration, or war fighting experiment location. Elements of the system can be stand-alone operated, remotely deployed and operated, employed in locations and on terrain that present systems cannot currently access and support, and conduct test missions over naval sea ranges on a shipboard platform.

Benefits

Current instrumentation on test ranges is limited to providing low-performance tracking, typically of single targets. As a result, real and virtual target entities would overwhelm current acquisition and tracking methods. The AMOAS project will overcome today's inability to capture and analyze comprehensive live test data by tracking hundreds of low optical, low radar cross-section targets from dispense to their multiple points of impact. As an added benefit, AMOAS will also have to ability to integrate virtual entities into the data field if such additional targets were required for a given test or training scenario. Furthermore, existing testing shortfalls will be met or exceeded by providing increased sensitivity for extended range tracking, increased processing for real-time and post-flight analysis, miss distance measurements, and kill assessments. This kind of data is required in hit-to-kill weapon system test scenarios like National Missile Defense, Navy Area Theater Ballistic Missile Defense and Theater High Altitude Area Defense, which require highly accurate measurements. The AMOAS will be capable of verifying and validating various radio frequency target signatures and providing target classification and discrimination.

Progress & Completion

During FY00, work was completed on the Test Capabilities Requirements Document. Work was also completed on the preliminary design of the active Transmit/Receive modules, space-fed antenna architecture, antenna/lens cooling system optimization, and antenna/lens packaging analyses. Additionally, scalability/ mobility studies were conducted and completed, including analysis of land and air transportation, antenna/radar power consumption/heat dissipation studies, and preliminary antenna production cost estimates.

The AMOAS team established a panel to define APAR system technical requirements for the test ranges and to solicit the range needs for an APAR.
Through the continued efforts of the team, the DoD community identified and responded with a need for seven APARs at the following ranges: White Sands Missile Range, Naval Air Warfare Center (Aircraft Division), Naval Air Warfare Center (Weapons Division), Navy Pacific Missile Range Facility, Naval Atlantic Fleet Weapons Training Facility, and Eglin Air Force Base. An effort has begun to ensure that the Army's APAR requirements are properly documented and tracked from the range through the Development Test Command to the Army Test and Evaluation Command and that the other service requirements for APARs are similarly documented and tracked through their respective Service headquarters. The APAR requirements report is expected to be completed by the third quarter of FY01. The Programmable Resource Control for the Multiple Object Tracking Radar (PRC MOTR) is being conducted as part of a two-phase effort under the AMOAS program. Under the PRC MOTR effort, the ability for console automation/radar resource scripting will be developed, as well as off-loading of console operations from the MOTR's RSX computer, improving both system efficiency and reliability in the process. Additionally, the MOTR will receive the ability for remote control/monitoring, improved real time and post flight data reporting, and two new operator consoles.A decision to enter into sensor development and fabrication is planned for the end of FY 01. Contingent upon a favorable decision, development and fabrication of the AMOAS subsystem hardware will begin in FY 02 with APAR, and the remaining AMOAS hardware will follow, beginning in late FY 02 through FY 04 with the C3DRV, ASR, and DOI.

Milestones	FY01				FY02				FY03				FY04			
Design	x	x	x													
Critical Design Review				x												
Fabricate Install Integrate					x	x	x	x								
System Test									x	x	x	x				
IOC													x			
FOC														x		

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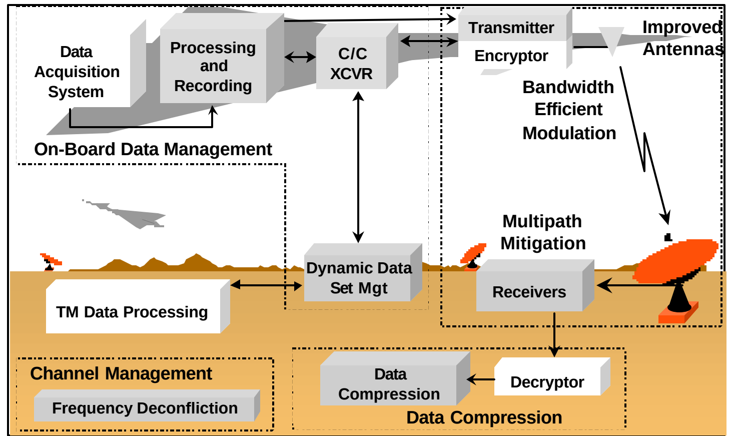
Advanced Range Telemetry (ARTM)



The ARTM program will improve the efficiency, reliability, utility, and availability of aeronautical telemetry (TM) spectrum. This will be accomplished by developing a variety of system upgrades that can be implemented at DoD Major Range Test Facility Base (MRTFB) locations. The technical approach to meeting the objectives of ARTM is based on limiting risk by mainly adapting "off-the-shelf" commercial communication technology that can be adapted and applied to aeronautical TM.

Requirement

For as long as the DoD has been conducting flight test, there has been a need for real-time data from aeronautical test vehicles. The need for TM systems has become as basic as the need for airspace or runways. Regardless of the Service or type of test vehicle, TM is a requirement for DoD air vehicle testing.

Real-time aircraft and missile test telemetry TM data requirements have grown exponentially. This is primarily due to the increased technical complexity of weapons systems and military air vehicles. As this complexity grows, more real-time flight test data is required to maintain an acceptable level of test safety and efficiency. However, the electromagnetic spectrum allocated to aeronautical flight test has decreased over the past few years and continues to be threatened by the commercial telecommunications industry. The DoD test and training community must satisfy customer needs for higher throughput and improved reliability of real-time TM data – in a limited spectrum environment – to avoid creating a bottleneck in the weapons systems acquisition process.

Description

Advances in the commercial telecommunications industry will primarily drive the ARTM technical approach. The development of new capabilities will focus on adapting these advances to aeronautical TM. The key technical concept areas are described below:

- Bandwidth Efficient Modulation. A vast majority of the current aeronautical TM systems use Pulse Coded Modulation/Frequency Modulation (PCM/FM). Higher order modulation techniques will be implemented into upgraded airborne transmitters and ground receivers.
- Multipath Mitigation. In order to improve data quality at the higher data rates, system improvements must be made. These improvements include the use of equalization, error coding and correction, and space or frequency diversity.
- Channel Management. Existing frequency scheduling and deconfliction tools were not designed to optimize the use of the aeronautical TM spectrum. An improved system will be developed and integrated with range scheduling systems.
- Data Compression. There are many "loss-less" data compression techniques that decrease the bandwidth required for applications in teleommunications and data storage. A family of such techniques will be implemented into airborne equipment and ground stations for use by test ranges.
- Improved Antennas. The design and application of test vehicle antennas has an enormous effect on the reliability of TM systems. New antenna designs or test vehicle configurations will be introduced to improve TM performance and ensure compatibility with other aircraft systems.

Benefits

The major benefit of ARTM is the improvement in the capability and capacity of DoD test ranges. These improvements will directly result in the avoidance of increased cost and schedule due to the limited amount of spectrum or unreliable TM data links. Additional benefits of ARTM will be commonality, interoperability, and standardization. Through this cooperative effort, MRTFB ranges will improve the overall test infrastructure and provide a baseline that is economical to establish, operate, and maintain.

Progress & Completion

In 2000, much of the ARTM effort focused on the development of initial production telemetry transmitter and receiving equipment. These modified commercial off-the-shelf products will effectively double the spectral efficiency of current range equipment. Some of these items have been delivered and are currently undergoing acceptance testing. In addition, the project made significant strides in the development of technology to improve the reliability of DoD TM systems – including equalizers, advanced antennas, and TM/Global Positioning System compatibility. Finally, the successful testing of alternative higher order modulation prototype equipment has demonstrated promising potential for continued improvements in DoD TM efficiency.

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Milestones	FY01				FY02				FY03			
Phase II												
Tier I Modulation FOC		x										
Tier II Modulation FOC							x					
Data Compression FOC								x				
Multipath Mitigation FOC								x				
Chan Management FOC					x							
Advanced Antenna FOC											x	
On-Board Data Mgt FOC											x	
Range Integration												x

Airborne Icing Tanker (AIT)

Note: This project is also receiving funding from the Federal Aviation Administration.

The AIT project is developing an airborne icing capability for testing aircraft systems. The capability will provide test mission support at both high and low altitude, have long duration flight time, and will suitably represent natural rain and icing conditions.

Requirements

Artificial icing and rain testing must be conducted to ensure that DoD weapon systems are capable of operating under normally occurring atmospheric conditions. The general requirement for adverse weather testing, which includes atmospheric ice and rain conditions, is set forth in Air Force Regulation 80-31, *All-Weather Qualification Program for Air Force Systems and Material* and Federal Aviation Administration (FAA) regulation (FAR) Part 25 Appendix C.

With new weapon systems on the horizon and increased commercial air traffic, the requirement for in-flight icing tests and effects of heavy rain on aircraft performance has become more urgent. An aircraft's ability to handle ice and rain conditions must be explored to prevent the potential loss of aircraft, crew, and passengers. Testing under naturally occurring icing conditions is too expensive, and more importantly, too dangerous.

Description

The AIT project will draw heavily from past testing experience. Proven hardware and technology are being used to the maximum extent possible. New designs and system configurations are being used to improve coverage of the FAR Part 25 Appendix C and provide super-cooled large water droplet conditions.

The primary components of the system include a multi-role KC-135R aircraft, Icing/Water Spray System, Flight Test Engineer's Console, Camera/Video System, Air Source, and a Boom System. The Flight Test Engineer's Console is used to create and monitor the proper mixture of hot air pressure and the water flow to provide the desired cloud physics. The Air Source provides the hot pressurized air to atomize the water. The hot air also keeps the spray array from accreting ice. The Ice/Water Spray System creates a rain or ice cloud, which forms over the area of interest on the system that is being tested. The buildup of ice or rain is monitored and recorded by the video camera equipment. There is also a laser measuring system, which monitors the proper distance each system maintains from the AIT.

Benefits

The AIT will be truly a national asset. Both DoD and commercial users of this test capability will have a consistent means of replicating natural in-flight icing conditions. They will be able to conduct the testing according to their schedule and location constraints, allowing savings of time and money. In addition, this project has the capability to improve safety; testing can be done in an environment that does not expose the system to undue flight condition risk and the possible loss of life.

It is anticipated that in the first year of use, the AIT aircraft will be extensively due to the pent up demand for this capability. Since the aircraft will retain its refueling capability, it will also be used by other paying customers for aerial refueling support and C-135 testbed purposes, thus helping to amortize the operating costs. The F-22, F/A-18E/F, CV-22, MV-22, and Joint Strike Fighter will make extensive use of this test capability. The AIT aircraft will also be available to the FAA for use in the testing of commercial aircraft.

Progress & Completion

The AIT is fully endorsed by the FAA. An Interagency Agreement between the FAA and the Air Force Flight Test Center was signed in October 1998. The FAA offered their financial support for the duration of the CTEIP project.

In February 2000, the AIT project was approved to transition into Phase II of its development. Major accomplishments in FY00 were the completion of AIT documentation (e.g. specification), Preliminary and Critical Design Reviews, and airfoil wind tunnel tests of spray array.

The main technical efforts to be pursued during FY01 are the fabrication, installation, and ground system level testing of the AIT system. This will be followed by flight testing to verify that flying qualities of the aircraft are maintained. Flight calibration testing of the ice cloud will be conducted in FY02. Initial Operational Capability (IOC) is scheduled for the third quarter of FY02 in support of the F-22 and F-18E/F.

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Milestones	FY01				FY02			
Fabricate Install Integrate	x	x	x	x				
System Test					x	x	x	
IOC							x	
FOC								x

Big Crow Electronics Warfare Enhancement Project (BCEP)

The BCEP comprises efforts to modernize existing Big Crow electronic warfare (EW) equipment suites to enhance their threat fidelity and test efficiency. The program will develop new suites of specialized electronic warfare (EW) mission equipment and instrumentation. The end product of the BCEP will be a system that is capable of providing realistic electromagnetic radiation threat environments for new weapons systems in Test and Evaluation (T&E) scenarios as well as for operational training exercises. The Big Crow platforms will also be available for contingency military operations as tasked.

Requirement

The Big Crow Program Office (BCPO) provides the capability to generate cost-effective, realistic threat, test and training environments with its EW suites, using the KC-135 and other fixed and rotary wing aircraft and mobile ground platforms. However, the 1970s-era technology currently incorporated in Big Crow's equipment is unable to meet new and emerging T&E and operational training needs. Specific areas of concern include limited effective radiated power, limited simultaneous emission capability, the inability to generate complex wide bandwidth waveforms, limited emitter identification and direction finding capabilities, low digitization and data recording rates, lack of responsive techniques, and limited data communication with other test platforms.

Many advances in the form of hybridization and commercial-off-the-shelf (COTS) technology are rapidly being incorporated into offensive and defensive threat systems, communications equipment, and surveillance sensors. Among others, the changes in the electromagnetic environment include wide bandwidth complex waveforms, adaptive processing algorithms, anti-jamming countermeasures, and low probability of intercept emissions. This use of advanced technology not only applies to current generation systems, but also to older systems that have been modernized through hybridization techniques, upgrades, or through the use of COTS. An ability is required that will support system of system level testing by providing the integrated EW threat to networked communications, command control and data links, and radars. Enhanced airborne capabilities to conduct radar and telemetry intercept in support of ballistic missile engagements are also needed, as are stand-off capabilities associated with additive and multiple threats and safety of flight outside a missile envelope.

Description

The BCEP will significantly expand Big Crows ability to:

- Receive, locate, analyze, and process wideband signals with complex modulation schemes;
- Develop and implement vector signal processing, high speed digitization, and data recording;
- Use differential GPS;
- Develop a new real-time situational awareness capability for the command, control, and communications suite;
- Track high velocity, small cross-section targets at long range; and
- Provide increased effective radiated isotropic power capability across the frequency spectrum.

For maximum flexibility, the project will emphasize open architecture system level design using, to the maximum extent possible, COTS components with industry standard interfaces. Use of an open architecture approach will assure forward compatibility with future upgrades and backward compatibility with existing Big Crow EW signal generation/transmission equipment and instrumentation. The resulting enhanced Big Crow system will be more flexible, alterable, and multi-functional. Support will be enhanced for test applications such as the use of high power pulsed amplifier and wideband receivers in support of airborne active and bi-static radar testing, the determination of reentry launch vehicle trajectories, and collection of intercept and debris field data. The same equipment will provide responsive countermeasure and threat simulations to assess improvements to advanced radars and radar systems.

Benefits

Benefits of the BCEP will be numerous. The addition of wide bandwidth complex waveforms, wide bandwidth receivers and high-speed digitization will provide the capability to test and exercise the increasing number of wideband communication and sensor systems being deployed. The proposed wide bandwidth capabilities also significantly improve the range resolution of the Big Crow radar, thereby providing more detailed and more accurate radar phenomenology data. This applies to both monostatic and bistatic radar operation.

With advances in technology, new systems are operating in higher frequency bands. It is not unusual to see systems operating in the 18 to 45 GHz range and above. High power transmitting capability in these frequency bands will provide the ability to perform EW testing on these systems. In addition, high power pulsed transmitters in the more traditional frequency bands will provide increased sensitivity and improved range performance for the Big Crow radar system.

The advent of rapid and powerful microprocessors has led to an increase in the number and complexity of responsive EW systems. BCEP will augment Big Crow's current responsive capabilities and provide the ability to create realistic, complex threat environments in a cost effective manner.

The addition of a differential GPS capability will enable more accurate positioning of airborne assets required for certain tests such as antenna characterization. The ability of Big Crow to emit and receive multiple signals from a single platform, such as when using the NKC-135 in support of systems of systems testing, will permit more combining of both test and training, resulting in significant monetary savings.The level of open architecture in the BCEP will allow use of equipment on smaller platforms when technically appropriate, such as the UH-1 Huey and Jet Ranger II rotary wing aircraft or Lear and Gulfstream fixed wing aircraft. Finally, the BCEP promotes savings by enhancing the reconfigurability of the transmit and receive and instrumentation elements for use in different multi-platform based radar, intercept, and jamming applications. Thus, maximum use of assets is assured since fewer dedicated stand-alone assets will be required.

Progress & Completion

Efforts in FY01 will be focused on identifying and gaining approval of detailed project capability test requirements.

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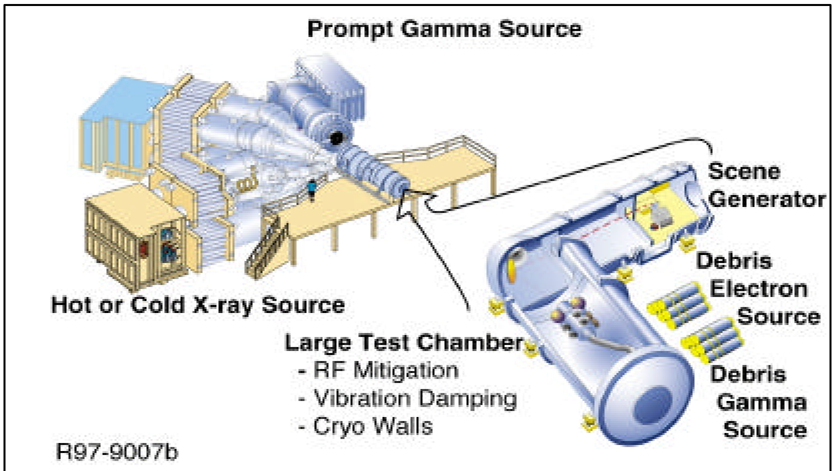
Milestones	FY01				FY02				FY03				FY04			
Design	x	x	x													
Critical Design Review				x												
Fabricate Install Integrate					x	x	x	x								
System Test									x	x	x	x				
IOC													x			
FOC														x		

Decade Radiation Test Facility Enhancement (DRTF-E)



DRTF-E will improve DoD's capability to simulate nuclear weapon effects (NWE) to verify the radiation hardness of critical military systems. It will provide a capability to test to the more demanding requirements (higher doses, dose-rates, combined environments, and fluences over larger areas) needed to ensure the survivability and reliability of strategic nuclear forces, missile defense initiatives, and critical space assets.

Requirement

DoD's capability to conduct NWE testing was severely curtailed with the banning of underground nuclear testing. This loss left DoD with a reduced capability to test and certify system performance against several NWE, including cold and warm x-ray induced thermostructural responses and high dose and dose-rate hot X-ray induced electronic responses. The CTEIP-funded DRTF-E will meet the requirement to validate the nuclear hardness of missile defense interceptors, space-based surveillance and communication systems, and strategic systems, and verify their survivability to NWE.

Description

When completed, the DRTF-E project will provide a suite of NWE simulators located at Arnold Engineering Development Center (AEDC). When the facility is fully operational, it will be able to simulate many elements of the space environment, including hostile nuclear effects. The facility will be able to provide test capabilities including medium area cold X-rays, prompt gamma radiation, debris gamma and beta radiation, and a sensor test bed consisting of a cryogenic vacuum chamber with an infrared scene generation and nuclear clutter simulation. The facility will also be connected to hardware-in-the-loop facilities located at other facilities, thus allowing tests with active command and control to directly import data for simulations with different test scenarios.

Benefits

The DRTF-E represents a step forward in the ability to simulate a wide range of NWE. One of the most significant benefits of this new test capability will be the ability to perform nuclear hardness and verification of combined nuclear effects. This new test capability also provides the significant benefit of more complete simulation of operational space environments in addition to hostile nuclear environments.

This test capability allows subsystem certification at higher levels of integration to validate hardening designs that must now depend solely on modeling. It will also provide the capability to perform tests for code validation and verification. By conducting testing at the subsystem and system level, the risk of vulnerabilities resulting from unanticipated component and sub-system interactions can be avoided.

A suite of simulators located at a single site that can perform a multitude of nuclear weapon effects simulations eliminates the requirement to transport test objects to many individual simulators. This allows the tester to develop and implement an integrated test plan, resulting in reduced test costs. Furthermore, the location of the DRTF-E at AEDC will allow testers to integrate NWE testing with other required testing that can be accomplished at AEDC, further reducing costs.

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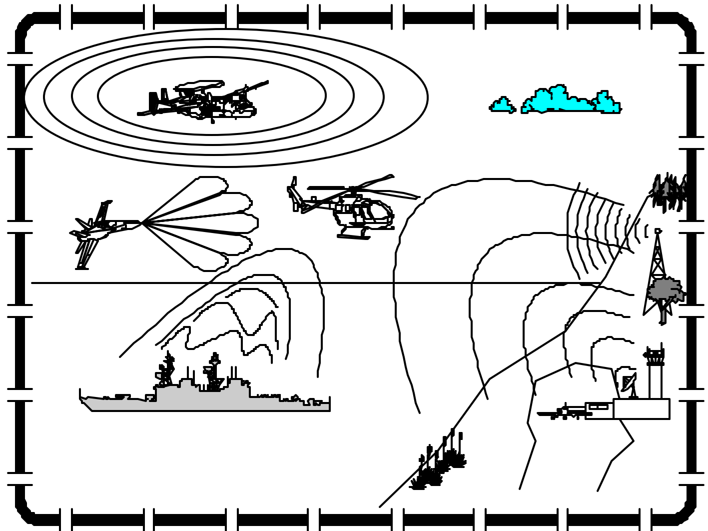
Milestones		FY01				FY02				FY03				FY04				FY05		
Requirements Definition / Design Efforts	x	x	x	x	x	x	x	x	x	x	x	x								
Design Reviews		x		x		x														
Sensor Test Chamber						x	x	x	x	x	x	x	x	x	x	x	x	x		
Prompt Gamma										x	x	x	x	x	x	x				
Debris Electrons & Gamma							x	x	x	x	x	x	x							
Second Quad										x	x	x	x	x	x	x				
Integrated Cold X-ray Plasma Radiation Source																	x	x	x	x
Facility Integration					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
IOC													x							
FOC																			x	

Electromagnetic Environmental Effects Generating System (E3GS)



The E3GS project will provide a multi-Service test facility capable of assessing the actual performance of full-scale, fixed, or rotary-winged aircraft completely immersed in a user-specified, high intensity, radio frequency (RF) environment. The test facility will be capable of generating radar frequency environments over the 10 kHz to 40 GHz frequency range with average field intensity levels of 200 Volts/meter and a peak field intensity of 30,000 V/m. The facility will be part of the Air Combat Environment Test and Evaluation Facility at the Naval Air Warfare Center Patuxent River, MD. The current installed systems are collectively referred to as the Electromagnetic Environment Generating System.

Requirement

Military aircraft are required to accomplish their missions in a diverse electromagnetic environment (EME). Forces operating in littoral regions will encounter battle spaces characterized by dense electromagnetic radiation from friendly, neutral, and hostile sources. Navy ships abound with high-powered radars, air bases contain powerful emitters, air corridors are frequently in close proximity to radio and TV stations, and the combat airspace itself will naturally be subject to intense electronic activity. More comprehensive testing is required to ensure that military aircraft will meet performance and survivability specifications while operating in a complex EME that includes high power, long duty cycles, and very high peak pulses, all over numerous frequency bands.

Description

Fully completed, the Electromagnetic Environmental Effects Generating System will consist of the following five primary systems:

- High Frequency (HF) Broadcast System Frequency Range 4-30 MHz, 250 kW output, 100% duty cycle.
- Very High Frequency (VHF) Pulsed System Frequency Range 170-200 MHz, 400 kW output, 7% duty cycle.
- Ultra High Frequency (UHF) Pulsed System Frequency Range 850-950 MHz, 400 kW output, 10% duty cycle.
- Microwave Narrow Pulsed System Frequency Range 1-40 GHz, 5 MW output, 0.1% duty cycle.
- Microwave Wide Pulsed System Frequency Range 1-10 GHz, 1 MW output, 25% duty cycle.

To facilitate the E3GS features, the design strategy includes provisions to support operations for all five systems. This provides subsystem similarity, commonality in operational approach, and ease in interfacing various test equipment suites into each of the five systems. Specifically, the design strategy entails:

- Use of an IEEE-488 instrument bus, RS-232, or ethernet to facilitate interoperability, commonality, and supportability of all equipment;
- Acquisition and integration of a 1-40 GHz, 5-megawatt hard tube modulator to increase output power, provide for greater frequency coverage, a and affect the simulation of actual emitters;
- Acquisition and integration of a 400 kW, 10 % duty factors high power klystron to simulate the UHF radars and to provide higher output power and greater reliability;
- Acquisition and integration of a variety of antennas optimized to radiate aircraft size test articles in the near/far fields and at high power; and
- Development and integration of controlling, calibrating, and automated test execution software.

Progress & Completion

The contract for the development and manufacture of the HF antenna was awarded in FY98, and the antenna was received in FY00. The HF broadcast transmitter, whose contract was awarded in FY99 was also delivered in FY00.

The antenna and transmitter were integrated in that year, and IOC is scheduled to be achieved in early FY01.
The VHF system started development in FY98 and reached IOC in FY00. The system has been used for tests on the U.S. Army OH-58 and UH-60 helicopters. The contract for three remaining systems was awarded in FY00. The three systems will take two years to design, fabricate, integrate and install. IOC is planned for third quarter FY02.

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Milestones	FY01				FY02				FY03				FY04			
Design	x	x	x													
Critical Design Review				x												
Fabricate Install Integrate					x	x	x	x								
System Test									x	x	x	x				
IOC													x			
FOC														x		

Electromagnetic Transient Test and Evaluation Facility (EMTTEF)

The EMTTEF provides Electromagnetic Pulse (EMP), lightning, and electrostatic test facilities to evaluate the resources of full-scale aircraft, including small and cargo-sized aircraft. These facilities also support the test and evaluation of ground-based and mobile systems. The EMTTEF has and will continue to support all three Services, Foreign Military Sales, commercial customers, and other government agencies.

Requirement

As a result of advancing technology, the threat associated with electromagnetic transients is increasing. The increased use of composites, exotic materials, and complex, low-power microelectronics in aircraft and other weapon systems have increased susceptibility to this threat. Present and developing threat scenarios will increase aircraft system exposure to hostile and natural environments. All-weather flying requirements have increased the frequency of exposure to natural environments. MIL-STD-464 defines these aircraft system test requirements. Current test capabilities must be upgraded, while new capabilities are required to evaluate present and future aircraft and weapon systems.

Description

This project will enhance the present EMTTEF and develop new test environments and capabilities in EMP, lightning, and electrostatic charge to correct the present shortfalls in meeting the electromagnetic transient (EMT) environments identified in MIL-STD-464. It is a three-phase project with the required CTEIP documentation developed in Phase I. Developments in Phase II will provide a Lightning Waveform A simulator and increased data acquisition bandwidth. New lightning multi-burst and multi-stroke capabilities, a new EMP simulator, and PC-based data acquisition will be developed in Phase III.

Benefits

Developing new capabilities to add to the present EMT test capabilities that will correct shortfalls in meeting testing requirements and provide significant mobility and automation to increase response and efficiency. The enhanced test capability will improve mission performance, enhance survivability in both combat and natural environments, and improve life-cycle support to operational systems.

Progress & Completion

All required documentation for this project has been approved. A prototype mobile Waveform Lightning simulator was finished and supported one Navy and two Army tests. Wideband fiber optic data links have been evaluated and a contract is in place to support acquiring the links to increase data acquisition bandwidth. A prototype mobile electrostatic prototype was completed and used to support one Marine and one Navy test. The final configuration and documentation of above prototypes will be completed by the end of FY01. All developments planned under this project are scheduled for completion in 2004.

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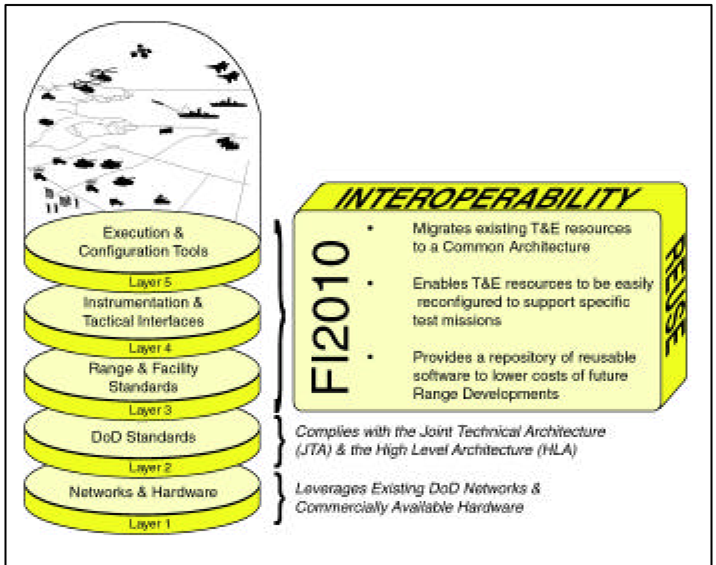
Milestones	FY01				FY02				FY03				FY04			
Design	x	x	x													
Critical Design Review				x												
Fabricate Install Integrate					x	x	x	x								
System Test									x	x	x	x				
IOC													x			
FOC														x		

Foundation Initiative 2010 (FI 2010)



The FI 2010 project is developing and validating the core products to enable the interoperability necessary to create synthetic battle-spaces consisting of actual weapon systems at multiple ranges, system components in hardware-in-the-loop facilities, and/or simulations of weapon systems. Furthermore, through the establishment of a common architecture, reuse and interoperability of range assets will be tremendously improved, reducing range development, operation, and maintenance costs.

Requirement

To validate weapon system performance requirements in a cost-effective manner, interoperability and reuse of resources within the test community are needed. Test resource constraints, such as safety, funding, environmental, and or treaty-compliance issues, often limit live testing to the collection of a few critical data points. Without complementary modeling and simulation capabilities, these limitations may result in the fielding of future war-fighting systems that do not fully meet operational requirements. Incorporating all design considerations, a simulation-based acquisition process is being pursued by the DoD to reduce time, risk, and cost of development for future weapon systems.

Description

In 1998, four CTEIP projects (the Test and Training Enabling Architecture; the Common Display, Analysis, and Processing System; the Virtual Test and Training Range; and the Joint Regional Range Complex) were merged to establish the FI 2010 project. The FI 2010 project is developing and validating a common architecture, a core set of tools, inter-range communication capabilities, interfaces to existing range assets, and a repository of reusable software interfaces to weapon systems, along with recommended procedures for conducting synthetic test events or training exercises.

The common architecture, referred to as the Test and Training Enabling Architecture (TENA), will be compliant with the DoD High Level Architecture (HLA) for simulations. It will address those areas of test requirements not supported by HLA and drastically improve the ability of ranges to interact with simulations. The FI 2010 project is coordinating with the Range Commanders Council so that TENA standards and protocols are reviewed and adopted by the range community.

The core set of tools is a suite of key software applications to assist range engineers in planning, configuring, controlling, and analyzing synthetic and multiple range exercises. These TENA- compliant software tools will enhance the productivity of the range engineer so that planning and reconfiguring for large-scale synthetic exercises can be accomplished much faster and with higher reliability.

The inter-range communication capabilities will validate that the products developed by the project can function over both organic DoD wide-area networks and commercial communication services. They will also evaluate the necessary end equipment and encryption devices required to transfer large quantities of data between geographically dispersed locations in a TENA-compliant exercise.

The FI 2010 project will develop interfaces necessary for existing range resources to become TENA-compliant. These interfaces will cost-effectively enable current infrastructure to be adapted to this common architecture, rather than require that replacement systems be developed. Allowing weapon systems under test to be stimulated with a simulation, the FI 2010 project is also defining TENA interfaces for tactical systems. In addition, the FI 2010 project is documenting recommended procedures for test missions involving simulations or across multiple ranges as well as methods for making new instrumentation systems compliant with the common architecture.

Benefits

The overall capabilities of FI 2010 will promote interoperability and reusability among DoD ranges, facilities, and simulations. These capabilities will advance a simulation-based acquisition or a 'distributed engineering plant' methodology to streamline weapon system acquisition. Most importantly, once the FI 2010 capabilities of the Foundation Initiative 2010 are in use by the test and training communities, future inter-range operations, as well as instrumentation development and sustainment, will cost less and incur less risk.

The benefits from the above products include cost effective replacement of customized data links, enhanced exchange of mission data, organic TENA and HLA compliant capabilities at test sites to be leveraged for future HLA/TENA test events, and instrumentation system software reuse.

Progress & Completion

The baseline TENA architecture was refined and the HLA/TENA initial comparison was completed through a series of three successful exercises in FY98. During FY 99 and FY00, the project developed and tested the first TENA prototype. The Baseline TENA architecture has been refined, and the HLA/TENA initial comparison has been completed. Through the use of project exercises, the following products have been delivered to the ranges: prototype federate software for Eglin Air Force Base Time-Space-Position-Information interface; working HLA-based interfaces for range data displays; prototype federate software for range data emulation; JADS SIT II prototype federation software; four SETI SubVTP HLA-compliant federates (certified under HLA compliance testing); and a SimHARM federation object model. This FY99 prototype effort both updated and validated a subset of the TENA Technical Reference Architecture that specifies the object model and services necessary to support distributed test and training exercises. This subset performed "representative range functionality," including interaction with HLA Federations. This software prototype was tested at six test ranges across the three Services and is scheduled to be deployed at both a test range and a training range Development Test Cell (DTC). During FY00, the FI 2010 team project supported the Joint Strike Fighter program in developing the scenarios and strategy to integrate three ranges during their Virtual Strike Warfare Environment 7 test event, which linked facilities at Patuxent River, MD, Wright-Patterson Air Force Base, OH, and Edwards Air Force Base, CA.

During FY01, the project will be developing the second TENA prototype with expanded functionalities. Using a rapid prototyping approach, the spiral construction of the TENA prototype is a risk reduction effort for key TENA concepts and allows test engineers at DoD ranges and facilities to quickly evaluate and refine the common architecture, so that they may be considered in other test or training environments. The process of creating TENA objects and integrating them into representative exercise systems is being documented to provide guidance for subsequent applications. In addition to the second prototype, the project will be reviewing several commercial-off-the-shelf software applications to serve as FI 2010 tools and developing the Object Definer and Resource Monitor tools during FY01. The project is on track and scheduled for FOC by the end of the fourth quarter of 2004.

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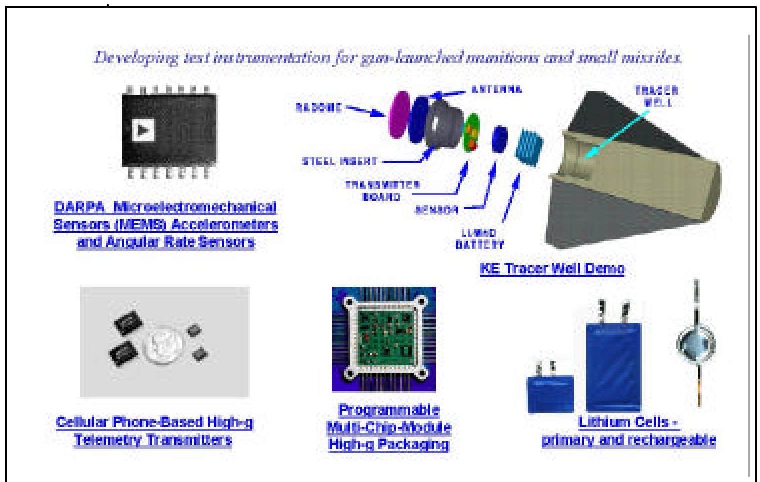
Milestones	FY01				FY02				FY03				FY04			
Architecture																
Software Development	x	x	x	x	x	x	x	x								
IOC								x								
Platform Expansion									x	x	x	x	x	x	x	x
FOC																x
Tools																
Definition of Tools	x	x	x	x												
COTS Review					x	x	x	x	x	x						
Tool Development							x	x	x	x	x	x	x	x	x	x
Final Delivery of Tools																x

Hardened Subminiature Telemetry and Sensor System (HSTSS)

The HSTSS project will develop and demonstrate a new generation of rugged, miniaturized, on-board instrumentation measurement technologies applicable to weapon system flight tests. The technologies will be relatively low-cost and will consist of several configurations designed for application in the direct fire, indirect fire, and missile system mission areas. A depiction of the objective system as it may be applied to a kinetic energy projectile is shown at right.



Requirement

Comprehensive measurement devices do not exist for very high-G projectile systems. Specific weapon system performance data such as acceleration; roll, pitch, and yaw rates; pointing angle at detonation; launch pressure on projectile base; and internal functioning currently cannot be collected routinely, efficiently, or cost effectively. Therefore, new methodologies and hardware must be developed to capture these measurements. The devices must provide continuous data from launch to impact, be nonintrusive to the unit-under-test, have a self-contained power source, and use standard transmission formats.

Description

HSTSS is developing a system that will provide direct measurements from launch to impact for a wide variety of munitions systems. It will be used to measure parameters such as attitude, velocities, accelerations, temperatures, pressures, internal processor functions, and sensor functions. This data will be telemetered to a standard range ground station and data analysis center. The system will have configurations unique to the host test articles and will not interfere with their static and dynamic performance characteristics. The system will have a modular design consisting of a power source, various sensors, a data acquisition module, a signal conditioning module, a transmitter, and antennas.

Benefits

The HSTSS project will provide an entirely new high-G instrumentation capability. The characteristics of the HSTSS devices, which are small, low power, and inexpensive, will provide features also attractive to lower-G systems such as missiles and smart bombs, where space and power limitations are severe.

Advanced technologies used in the HSTSS project include lithium-ion polymer flexible power supplies, hardened L- and S-band transmitters, multi-chip modules, micro-electromechanical sensors, and inertial measurement units.

Progress & Completion

The HSTSS project has awarded several development contracts for components of the system. Prototype high-G batteries commercially developed for use as cellular phone batteries are being tested. A transmitter development contract was awarded, with deliveries of prototype chipsets the first quarter of FY01. A Data Acquisition Chipset development contract was awarded, with the prototype chipset (Delay/Repeater) delivered in the third quarter of FY00. Development on crystal reference oscillators for applications in the 500G and 30k G range is complete, with development continuing on a crystal reference oscillator for 75k G and above applications. Packaging design studies and sensor development are continuing to reduce risk in system integration designs.

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Milestones	FY01				FY02				FY03				FY04			
Design	x	x	x													
Critical Design Review				x												
Fabricate Install Integrate					x	x	x	x								
System Test									x	x	x	x				
IOC													x			
FOC														x		

Holloman High Speed Test Track Upgrade

The HHSTT of the 846th Test Squadron, 46th Test Group, Holloman AFB, New Mexico, provides the only hypersonic sled test capability in the world. Hypersonic testing is conducted at the HHSTT to evaluate missile warheads and seekers, thermal protective materials, anti-armor weapons, fuzes, etc.

The HHSTT has been designated the test base for Theater Missile Defense (TMD) lethality testing. Both TMD warhead developmental testing and Live Fire Test & Evaluation are conducted. As payload/velocity requirements have increased to meet DoD needs, test success reliability has suffered. Additionally the HHSTT is from 25-50 years old and significant degradation has occurred to some of the facility infrastructure, which has also reduced test reliability. This program will develop techniques and capabilities necessary to improve the test success reliability at the HHSTT. Improvement of the track's reliability will also allow the HHSTT to provide increased payload, velocity, and instrumentation capabilities when required by test customers.

Requirement

Proliferation of theater range ballistic missiles like the SCUD has led to the development of systems to defend against this threat. Lethality of these defensive systems must be evaluated to make acquisition decisions and to support wartime defense planning. The HHSTT is the only facility capable of providing full-scale, high-fidelity lethality test and evaluation of these systems. Weapons systems in development that currently require lethality testing include the Army's Theater High Altitude Area Defense and Patriot Advanced Concepts III and the Navy's Standard Missile II and Standard Missile III.

Test failures at the HHSTT can contribute to delaying extremely important acquisition milestones and the fielding of critical Army and Navy TMD systems. The three major contributors to test failures at Holloman are all related to the interface between the test sled and the track itself. Test sleds are constrained to the track via slippers wrapped around the track rail. The slippers slide on the rail, which results in wear and can cause the slippers to fail before a test sled has delivered its payload to the intended target. Unfortunately, conventional lubrication techniques do not alleviate this problem at higher velocities. Secondly, at velocities above 5000 feet per second, slippers impacting the track rail exhibit a penetration phenomenon that can actually gouge the rail. During the creation of a rail gouge, the slipper is also gouged. These gouges can result in slipper failure and subsequent loss of the sled. Finally, since the slippers must slide on the rail, there is a small clearance between the slipper and the rail. When the slippers traverse the clearance gap, they impact the rail resulting in very high impact loads at hypersonic velocities. These impacts can lead to failure of either the test sled or its payload. Reducing slipper wear is dependent upon reducing the average pressure the slipper exerts on the rail, reducing the time and distance the slipper slides on the rail, and applying new wear resistant materials to slipper designs. Reducing rail gouging requires a reduction in the peak pressure exerted by the slipper on the rail, a reduction in the number of slipper/rail impacts that occur, and application of new materials on the slippers and protective coatings on the rail. Reducing the amplitude of the slipper/rail impact loads requires precise rail alignment, strong rail constraints, and increased slipper flexibility.

Description

This project consists of the design, development, fabrication and test of new slipper/rail interfaces to address slipper wear, rail gouging, and excessive impact loads as well as the development of a new rocket motor. The project is integrating new wear and gouge resistant materials developed in a Small Business Innovative Research project into HHSTT sled designs. Advanced hydrocode modeling tools are also being applied to predict wear and gouging. The project continues to develop structural dynamic impact models to predict the loads experienced by both the test sleds and the test items they carry. Based on these models, new sled design concepts are being developed to reduce the impact loads, and these designs have already begun to yield benefits. Further, the project is developing a new rocket motor to allow sleds to spend less time on the rail and thus reduce both wear and gouging. The new motor will also allow for sleds to be designed with vibration isolation features to reduce impact loads while maintaining current velocity/ payload capabilities.

Benefits

The HHSTT Upgrade will provide more reliability to current and future hypersonic test customers. Test success reliability for HHSTT customers will be increased to above 90% for tests at velocities up to Mach 7. The increased reliability will enable HHSTT customers to more accurately schedule their development efforts and will preclude the cost of test failures. Additionally, the cost for a sled test is approximately 10% of the cost of a flight test to gain comparable data.

Progress & Completion

Engineering efforts in the past year continue to result in improvements in the design and performance of hypersonic sleds. Mission reliability for 2000 hypersonic sled tests was 100%. The sled and slipper design for future hypersonic tests has been accomplished and the first sled has been manufactured and successfully run - providing important aerodynamic and force data at partial velocity. Advancements continue to be made in the dynamic modeling of sleds and the track rail. Modal and dynamic tests of both sleds and the rail were conducted to validate design models. Additionally, the design of the new rocket motor was completed, several prototype motors were manufactured, and one prototype motor was successfully static fired. Finally, the refurbishment and design effort for the narrow gage rail extension has been accomplished and the contract for the construction effort established.

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Milestones	FY01				FY02			
Sled/Facility Fabrication	x	x	x					
Rocket Motor Development	x	x	x	x				
Demonstration Sled Tests	x	x	x	x	x	x		
IOC							x	

Joint Advanced Missile Instrumentation (JAMI)

The JAMI project will develop a package of integrated instrumentation components for applications in tri-Service small missile test and training to provide support telemetry, time-space-position information (TSPI), flight termination, and end-game scoring in a low-cost, modular package that will allow worldwide test and training. JAMI will, in most cases, eliminate the need for range-specific (or multi-system) facilities. JAMI will incorporate Global Positional System (GPS)-based technology as the TSPI and vector- scoring engine. It will also use state-of-the-art telemetry and an off-the-shelf ultra high frequency flight termination receiver, coupled with a miniature, solid state, programmable safe and arm device. Components will be qualified and tested in flight as an integrated package in a missile system.

Requirement

For testing applications, missiles must be instrumented to provide four range functions: telemetry, TSPI, flight termination, and end-game scoring. There is no single, airborne instrumentation package that supports all four functions, and the instrumentation that does exist is range-specific. Additionally, a cost-effective solution is needed for end-game scoring systems that currently use old technology.

Description

The JAMI effort consists of the development and integration of several components to provide the aforementioned four functions and to then demonstrate these four functional areas in one integrated platform. One of the project's objectives for flight termination is the development of miniature, dual-redundant flight termination hardware that will be pre-qualified to existing missile environmental levels. Another product to be delivered is a design toolbox, which will be an electronic database that includes information on JAMI-qualified hardware, qualification test reports, telemetry system design tools such as range telemetry link calculations, and programmable component interfaces.

In 1999, the Office of the Secretary of Defense formed an Integrated Process Team (IPT) to coordinate the efforts of a number of CTEIP projects to ensure they were integrated into a seamless Range Control System of Systems for target control, missile instrumentation and shooter track. JAMI (missile instrumentation), along with the Multi-Service Target Control System (target control) comes under this IPT and is a full participant.

Benefits

JAMI will improve the capabilities of the test ranges by enhancing or providing the instrumentation for small missile platforms. The JAMI flight termination solution will provide a family of qualified components, thus reducing or eliminating qualification costs for missile or target platforms. The JAMI TSPI solution will provide an added capability to track low-flying targets and missiles that fly below the radar horizon. This will reduce safety risks by providing accurate tracking throughout the duration of flights. Cost savings may result from the alleviation of the need to clear a large range area. JAMI will also provide instrumentation to support an end-game scoring solution for the missile-target intercept. Such a capability will not only provide the data to determine lethality performance, but when provided within minutes of the intercept, will allow the decision to launch another weapon within the same range time, saving costs associated with a follow-on test event. JAMI will enhance interoperability by reducing the need for unique range infrastructure.

Progress and Completion

A two-phased developmental approach has been completed. Phase I validated the requirement for end-gamescoring and evaluated existing low cost GPS hardware to determine the accuracy and dynamic robustness of existing receivers. A low dynamic GPS receiver package was successfully developed and tested. A preliminary design review for this package is scheduled for the second quarter FY01. This phase also investigated the achievable performance and complexity of alternative techniques in kinematic processing. An assessment was made of the achievable accuracy of existing GPS technology without resorting to kinematic techniques.

An agreement for the development of a miniaturized Flight Termination Safe and Arm device (FTS&A) was reached with a commercial partner and the FTS&A has successfully passed completed a preliminary design review. Qualification on production hardware is expected to start the third quarter of FY01.

One of the early important tests that the JAMI program will conduct for TSPI will be a Sidewinder missile intercept of a drone. Both the missile and drone will be instrumented with a GPS receiver and the support instrumentation to link this data to the ground. During the test, the GPS data from the drone will be processed and displayed on JAMI displays and on the Range Control Centers display. Results of this test will help define the use of a GPS receiver in support of TSPI tracking and in post processing to determine end-game vector scoring. Additionally, the data will be used to later help evaluate software packages proposed for end-game scoring. The hardware for the missile and targets and the ground station support for the test have been completed, and the captive carry flights and firings occurred in the first third quarter of FY00. Initial captive flights suggested that the antenna patterns needed to be improved for captive carriage due to aircraft reflections. Further antenna development is being explored, and the missile/drone launch is planned for the second quarter of FY01.

A high dynamic GPS receiver system is under development. JAMI and another CTEIP project, Hardened Subminiature Telemetry and Sensor Scoring System (HSTSS), let a developmental contract on a high dynamic receiver, which is expected to be in place by the first quarter of FY00 with delivery of proof-of-concept hardware in the first quarter of FY01. Component evaluation will determine if a GPS receiver technology is mature enough to support high dynamic missile TSPI and end game scoring requirements.

A memorandum of agreement (MOA) with the Tomahawk program was signed with JAMI to integrate a low dynamic GPS system. A conceptual design for an encoder and GPS receiver was completed, and the specification for the system drafted. Hardware for this program is expected to begin undergoing qualification testing in the second quarter of FY01. A similar MOA was signed with the Advanced Medium Range Air-to-Air Missile program to integrate the high dynamic JAMI TSPI Unit into the Airborne Instrumentation Unit currently being developed. The last MOA for a “platform-X” missile is in discussion, and will represent the integration of all of the JAMI-developed components FTS&A and the airborne TSPI Unit), as well as integrating components from HSTSS and possibly another CTEIP project, Advanced Range Telemetry (ARTM), to provide a single miniaturized instrumentation system. This missile configuration will be flown against a target platform that will similarly have a JAMI TSPI Integrated Module (for downlinking data to the ground). Data from both of these platforms will be processed in a Range Telemetry ground station. TSPI track will be displayed in real time, and the vector scoring solution will be post processed. JAMI IOC is planned for early FY04.

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Milestones	FY01				FY02				FY03				FY04			
FTS&A CRADA Development/Qualification	x	x	x													
Flight Termination Receiver Qualification		x	x	x	x											
Flight Termination Component Certification						x										
TSPI Unit Development/Qualification																
Low Dynamic configuration	x	x	x													
High Dynamic configuration		x	x	x	x	x	x	x								
JAMI TSPI Integrated Module (target)			x	x	x	x	x	x								
JAMI Data Processor (ground statation)																
TSPI Range display capability	x	x	x	x												
End Game Scoring capability		x	x	x	x	x	x									
Platform-X Integraton			x													
JAMI Component Flight Tes tDemo										x						
JAMI IOC														x		

Joint Installed Systems Test Facility Projects (JISTF)

To meet increasing test and evaluation requirements, the DoD has supported joint Army, Navy and Air Force efforts to develop installed capabilities for electronic combat ground testing. These Installed Systems Test Facilities, based on computer-controlled simulators and stimulators, can present high fidelity background, threat, and target environments to weapon systems and flight platforms under test and measure the resulting impacts and actions of the onboard systems in response to the stimuli.

Under the JISTF project, solutions are being developed to a requirement for mission representative, complex correlated infrared (IR), radar, and communications stimuli in a controlled ground test environment. Although the developed capabilities will be implemented at multiple sites employing differing infrastructures, close cooperation and coordination between test centers have ensured a high degree of commonality.

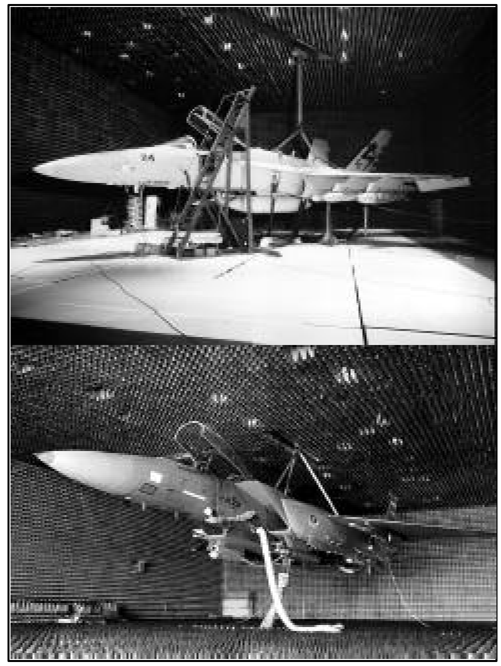
Requirement

With the increasing complexity of electronic combat over the past decade, more sophisticated test and evaluation is required to ensure that U.S. combat systems can effectively operate within their own generated electronic environment and against the multi-spectral radio frequency (RF) and electro-optical threat presented by an enemy. Newer aircraft systems with advanced, highly integrated, software-intensive avionics (such as the F-22, B-2, and F-18E/F) are requiring increasingly complex test and evaluation facilities. These facilities must be able to test a fully integrated aircraft in multi-spectral environments, including targets, threats, and background.

Description

Four major subprojects have been defined under JISTF and funded based on critical need and the ability to meet requirements with a common system. Each of these systems includes modeling and simulation and advanced hardware to provide specific real-time stimulation in a ground based test environment.

The Multispectral Scene Generator (MSSG) will provide a high fidelity scene projector for testing multi-mode (IR/RF/Millimeter Wave MW)) missile seekers through the use of high and low frequency beam combiners, IR scene



generators, and IR scene projectors.

The Communications, Navigation, Identification simulator (CNI) subproject will provide a wide range of high-fidelity friendly and threat signals for testing weapon systems through development of a Joint Data Link Simulator (JDLS) and Joint Communicator Simulator (JCS).

The Generic Radar Target Generator (GRTG) will present dynamic, multiple angle-of-arrival target and surface clutter radar returns to the system under test. The Air Force has been designated as lead Service for this subproject.

The Infrared Sensor Stimulator (IRSS) will provide a high fidelity scene projector for testing IR search and track, missile warning, and forward-looking IR sensors.

Benefits

DoD has pursued and funded activities designed to achieve improved installed systems test capabilities in a timely manner to meet projected test requirements. The ability to ground-test sophisticated weapon systems in an integrated test environment within an installed systems testing facility is absolutely necessary for effective and efficient hardware development and testing. The joint development and management approach implemented by DoD strives to maximize commonality between the stimulation requirements of two premier advanced electronic ground test facilities and tri-Service hardware-in-the-loop facilities.

Progress & Completion

During 2000, several of the JISTF subprojects reached either an initial or full operational capability (IOC/FOC).

The MSSG passed IOC in late 1999 with a delivered and proven T&E capability for IR/RF missile seekers in FY00. Now at IOC, the IRSS has been successfully tested against both the Navy's E-2C Surveillance Infrared Search and Track System and the F/A-18 Advanced Targeting FLIR. The JDLS is at FOC and has supported test events on EP-3, EA-6B and B-52 systems.

Having entered integration testing with the F-22 Radar, and IOC is expected for the GRTG in FY01 and the JCS hardware is complete with a system wide IOC expected during FY01.

Milestones	FY01			
IRSS Development				
Point Source Projection	x			
Signal Injection	x			
GRTG Development	x	x	x	
GRTG IOC			x	x
JCS Development	x	x	x	
JCS IOC				x

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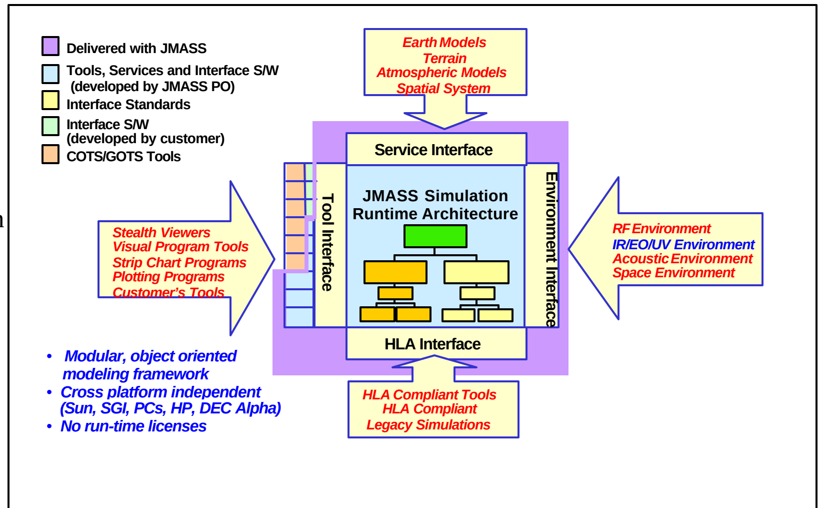
Joint Modeling and Simulation System (JMASS)



JMASS is a consistent, reusable engineering and engagement level simulation support environment. It fosters the development and reuse of models and simulations supporting concept evaluation, requirements definition, test criteria derivation, test design and prediction, and analysis of operating performance and effectiveness.

Requirement

The JMASS requirements are documented in the Joint Operational Requirements Document (JORD) dated August 31, 1998. The JORD has been coordinated and signed at the General Officer/Senior Executive Service level by the Army, Navy, Air Force, the Defense Intelligence Agency, and the Office of the Secretary of Defense.

At a very top level, JMASS is required to provide the capability to develop, execute, and post process the results of simulations at the engineering and engagement level. Various tools and services are required to support the acquisition and test and evaluation communities. During FY01, CTEIP funds will be used on six projects to meet the following requirements:

- Standard methodologies and procedures for testing models for JMASS compliance, and a facility that employs these methodologies and procedures for testing models;
- A standard Radio Frequency (RF) environment to support JMASS models and simulations;
- Informal and formal testing of the JMASS software to insure it meets the JORD IOC requirements;
- A standard suite of models that a model developer can use to test and exercise all the Application Programming Interfaces (APIs) of models prior to delivery to the program office;
- Methodologies to insure JMASS retains an open systems architecture and is incorporated into the commercial software market; and
- A forum for customers and developers to discuss needs, share experiences, success stories, lessons learned, and get technical assistance from other developers and JMASS experts.

Description

JMASS provides a systems-level architecture, which specifies a structure for simulations and their component models, the interrelationships between their component models, and the principles and guidelines governing their design and evolution. JMASS defines a set of standards and guidelines for building JMASS compliant models, for assembling the models to build JMASS simulations, for executing the simulation over time, and for analyzing results. JMASS includes a comprehensive set of documentation that describes the JMASS architecture, standards, and implementing software. The standardized models and simulations can be stored in a model library and reused by other users. The FY01 CTEIP funded projects are:

- Joint Compliance Test Facility (JCTF). A standard set of tests will be developed to insure models delivered by customers meet the JMASS interface. A standard test scenario will also be developed to insure that models integrate and operate properly with a JMASS scenario. Documentation ("How To" Users Manuals) will also be provided to assist model developers;
- JMASS Modular Object Oriented Simulation Environment (JMOOSE). Several different versions of the JMASS RF environment will be re-engineered into a single RF environment that will support JMASS simulations. The resulting environment will be configuration controlled;
- BETA/IOC Testing. The individual Services will conduct beta site testing of each JMASS software release. The Services will conduct

formal testing to insure JMASS meets their requirements;

- JTEST. A standard suite of simplistic models will be developed to assist model developers as they build their models. The suite will include models and documentation and will insure all the APIs application program interfaces of a model are exercised; and

- Standard Commercialization. The policies and procedures for the creation of an Institute of Electrical and Electronics Engineers (IEEE) standard will be researched and the results of the research will be used to develop a plan for making JMASS an IEEE standard.

Benefits

The major dividend of JMASS is a common software environment in which the government and contractors alike can develop and execute interoperable and reusable model components, reducing the cost and time to acquire systems. The JMASS projects funded by CTEIP accelerate the delivery of the required capability. The FY01 funded projects provide the following benefits:

- JCTF. A central location/facility with the neces sary tools and documentation to insure consistent, methodical model compliance testing. Additionally, the JCTF will develop and deliver a standard simulation integration process as well as a manual for analysts to use during model development and testing. These tools and documents will enhance the quality of testing while insuring model reuse.

- JMOOSE. A standard RF environment for integration and testing of JMASS models and simulations.

- Beta/IOC Testing. Insures Service customers are actively involved in defining and conducting testing (Beta and IOC). Enhances the quality and reliability of the product, while increasing the confidence of the customers in reusing JMASS models.

- JTEST. A standard model test suite and documentation for developers to use and follow while developing models. Reduces JMASS compliance issues prior to delivery to the JTCF. Enhances reuse of JMASS models by various users, including test agencies.

- Standard Commercialization. Begins the process to make JMASS an IEEE standard and insure JMASS retains an open systems architecture. Also allows users to customize systems to support all aspects of acquisition including test and evaluation.

Progress & Completion

All FY01 projects are on schedule. The Statements of Work for the JTCF, JMOOSE, JTEST, and Standard Commercialization have been written. The individual contracts are in various stages of negotiations and will be awarded in 2000. The Beta/IOC testing scenarios have been defined and the Beta and IOC test sites have been identified.

Five of the six efforts funded by CTEIP in FY00 have been completed and delivered within cost and schedule. The sixth, SPEEDES, is on schedule and within cost. SPEEDES is a risk reduction project to investigate the replacement of the JMASS simulation engine with the SPEEDES simulation engine and address several JMASS JORD requirements. These requirements include real-time execution of complex JMASS simulations, operating on high-performance parallel processing computers, and supporting distributed processing via the High Level Architecture. No FY01 funds will be used on SPEEDES.

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Land and Sea Vulnerability Test Capability (LSVTC)

Vulnerability and survivability determinations require accurate replication or simulation of all the components of the combat interactions envisioned: the system under test, the threat weapons or devices, the dynamic behavior of both, and the operational environment of the interaction. While the test articles themselves can usually be provided or adequately replicated, current vulnerability test facilities fall short in supporting the dynamics of engagements and faithful replication of system operating environments. New capabilities are needed to address these testing shortfalls.

Requirement

Live Fire Testing is required for all new acquisitions of major systems and existing system upgrades. Reliable determination of the vulnerability of military platforms and systems to threat weapons and operational hazards is of increasingly critical importance to future defense preparedness. Major changes to the national security strategy, decreasing force levels, an expanded range of threat weapons and mission environments, and recognition of the unacceptability of loss or major mission impairment to our limited number of warfighting systems combine to produce a growing need for highly credible yet affordable vulnerability testing. Existing facilities are insufficient to meet this need and are losing existing value as a consequence of environmental constraints and budget limitations. There is a clear need for an integrated, modern complex for assessment of the vulnerability of costly developmental systems under operationally realistic conditions.

Description

The purpose of the LSVTC initiative is to provide a versatile and integrated complex of test ranges and instrumentation that will enable accurate measurement and analysis of the vulnerability of military systems, subsystems, and components to the projected damaging effects of threat weapons. The same LSVTC can also facilitate determining the lethality of both deployed and developmental weapons against a range of targets. The LSVTC concept and design reflect the joint regional warfighting principles defined in the National Military Strategy and its derivative documents and focus on the critical vulnerabilities of systems operating in or near land/sea transition environments. By exploiting the potential of both existing facilities and new technologies, the LSVTC will achieve of a high degree of confidence in vulnerability and lethality test results while avoiding the increasingly serious environmental impacts associated with this type of testing in actual operational or training locations. The LSVTC will also directly support and significantly enhance the Services' ability to economically and safely execute Live Fire Testing.

To increase the operational relevance of vulnerability testing, LSVTC must support both static and dynamic vulnerability testing on a wide variety of test articles, including manned platforms, weapon systems, and components. It must also support this testing in operationally realistic littoral environments that replicate the range of physical conditions that may be encountered in the sea/land transition zones in various parts of the world.

There is also a requirement to determine the lethality of high-speed underwater munitions, various types of sea and land mines, and air- or ground-launched munitions against actual or surrogate threat targets. Toward this end, the LSVTC should use the same instrumentation, equipment and facilities required for the vulnerability testing initiatives.

Finally, the LSVTC's advanced data collection and analysis features will have an important role in validating computer simulation models, including vulnerability and lethality models. This will enable major savings for future acquisition programs by permitting the substitution of validated simulation-based testing for costly live testing.

The LSVTC project will leverage a $40 million investment already made by the Army and the Navy in the Underwater Explosive Test Facility at Aberdeen Test Center to address several current T&E shortfalls. This will include facility enhancements to address Amphibious and Beach

Landing Vulnerability; Littoral Region Testing; Mine/Countermine Lethality Testing; Special Operations in the Underwater Environment; Acoustic/Shock Effects of Underwater Explosions on Navy Weapon Systems; Underwater Missile/Torpedo Launch Capability; and the Prediction, Modeling, and Simulation of Water Ranges and Resulting Damage.

Benefits

Our warfighting personnel must have high confidence in their platforms and systems to allow them to extract all the combat performance that is expected and required for mission success in difficult combat scenarios. Essential to that end is a need to clearly prove the ability of the platforms and systems to survive weapon attacks, protect their crews, and continue to fight effectively after suffering damage. This is the foundation of the congressionally mandated Live Fire Test and Evaluation program. The groundwork for confidence must be laid well before the "final exam" represented by that process. The test and evaluation community recognizes the importance of improving and refining vulnerability and lethality testing throughout the acquisition cycle, so as to continually strengthen the credibility of the assessments performed. In this manner we will strengthen the trust and confidence of our warfighters in their systems.

Progress & Completion

The LSVTC team has been formed and required documentation has been completed. Upon approval of this documentation, the project will enter Phase II development. Final Operational Capability is scheduled for 2004.

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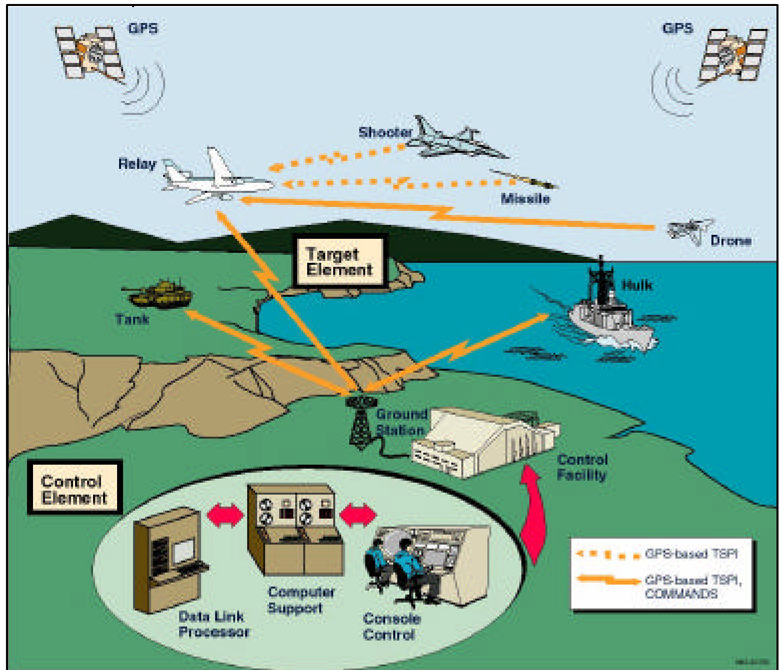
Milestones	FY01				FY02				FY03				FY04			
Design	x	x	x													
Critical Design Review				x												
Fabricate Install Integrate					x	x	x	x								
System Test									x	x	x	x				
IOC													x			
FOC																x

Multi-Service Target Control System (MSTCS)

The goal of the MSTCS project is to improve interoperability of Service target control systems. The MSTCS concept, as shown in the figure to the right is limited to target control only. The Office of the Secretary of Defense is coordinating other range control efforts to provide a seamless Test Range System of Systems (TR-SOS) capability for missile instrumentation and shooter track.



Requirement

In testing and training scenarios, it is necessary to present multiple target configurations of both surface and aerial targets in an electronically dense environment. Creating and controlling these scenarios has taxed target control systems to the point where some are unable to cope with the current test and evaluation and training scenarios.

Currently, there are a variety of target control systems (TCS) employed on ranges around the world. Each of these systems performs similar functions and may control the same classes of targets, however, they are not interchangeable or directly interoperable. Each of the principal ranges offers some unique environmental features that make target interoperability desirable. There is also a need to immediately upgrade deficient TCSs and to improve future supportability of all such systems.

Description

The MSTCS concept consists of two fundamental building blocks: a radio frequency link that will pass data in a manner that is spectrally efficient and reliable and an interoperable ground system that will improve on existing ground systems. To increase interoperability between the Navy radar-based system and similar Army/Air Force multi-lateration systems, MSTCS will address both building blocks. The tri-Service team will develop a new family of datalinks for all targets. An updated ground station will be developed that leverages existing fixed site software and includes new control consoles in fixed site, transportable, and deployable configurations.

Benefits

The MSTC System will provide the same or more capability than each of the Services' existing target control systems and will be in use for many years before the next major TCS upgrade is required . To maximize its utility while minimizing premature obsolescence, it will be designed with the newest, most affordable technology available.

Progress & Completion

Coordination of Phase I requirements and cost comparison of alternate solutions are complete. Phase II execution of the MSTCS schedule started in early FY00. It includes three early success initiatives and will reach full IOC in late FY05.

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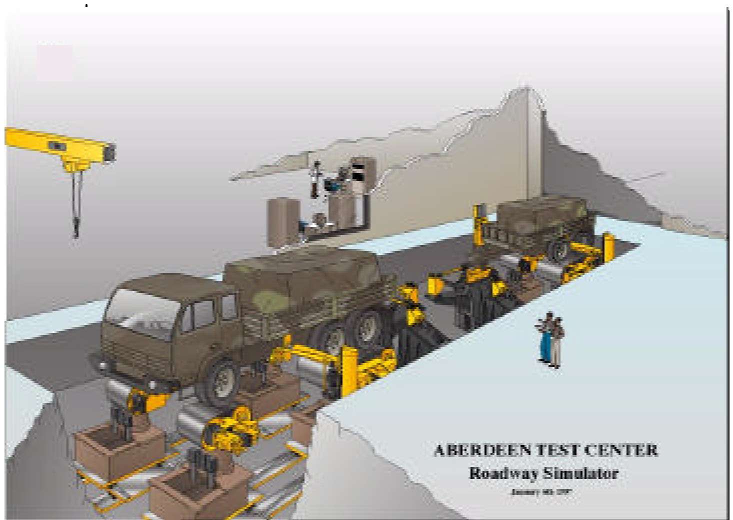
Milestones	FY01				FY02				FY03				FY04				FY05			
Contract Awards			x						x											
High Capacity Datalink R&D	x	x	x	x	x	x	x	x	x	x	x	x	x							
Low Capacity Datalink R&D			x	x	x	x	x	x	x	x	x	x	x							
Ground Control Systems R&D			x	x	x	x	x	x	x	x	x	x	x							
Control System Software R&D	x	xx	x	x	x	x	x	x	x	x	x	x	x							
System Integration								x	x	x	x	x	x	x	x	x	x	x		
System Test															x	x	x	x	x	x
IOC																				x

Roadway Simulator (RWS)



The RWS will provide a key land combat test and evaluation capability that will ensure the achievement of mobility goals described in Joint Vision 2010. This vehicle-in-the-loop simulator will support testing of advanced-mobility vehicles and other tactical vehicles in a laboratory environment, while addressing safety, engineering, and cost concerns. The simulator will support the test vehicle and allow it to fully operate through various driving profiles. The associated dynamics of the equivalent real-world test will be simulated to allow accurate measurements of performance to be made.

Requirement

No capabilities exist to safely, accurately, and completely test advanced-mobility vehicles being developed to meet Army, Marine Corps, and Special Operations Command requirements. The success of these revolutionary vehicles, and the doctrines that describe their usage, requires a major leap in land vehicle test capability and test technology. First generation, fast-attack vehicles are presently being tested at the U.S. Army Aberdeen Test Center, but at performance levels well below the vehicles' capabilities. Traditional test courses and test procedures cannot safely support operation of advanced-mobility vehicles at the desired performance levels simply because the likelihood of vehicle accidents is too great at these higher speeds.

Current land vehicle test and evaluation (T&E) resources also do not support critical initiatives to streamline system acquisition by integrating T&E early in the acquisition cycle and capitalizing on the benefits of modeling and simulation. Simulation resources, historically used with great success in the aircraft and automotive industries for vehicle T&E, are extremely scarce for testing heavy, high-performance military vehicles and simply do not exist in a form that accurately replicates real-world dynamics. As a result, extensive testing is not initiated until after final design and manufacture of pre-production vehicles. Failures at the proving grounds consequently translate to high re-engineering and re-manufacture costs, as well as program delays. In summary, the RWS will address the following shortfalls:

- No capability currently exists to safely, accu rately, and completely test advanced mobility vehicles currently being developed.
- Land vehicle testing, if completed too late in the acquisition cycle, results in high re-engineering and re-manufacturing costs.
- Current land vehicle test resources and methodologies do not effectively support modeling and simulation initiatives, such as Simulation-based Acquisition (SBA).

Description

The RWS will be a vehicle-in-the-loop simulator used to test the safety and performance of military trucks, tractor-trailer combinations, and other wheeled military vehicles in a laboratory environment, allowing for engineering, test safety, data quality, and test cost concerns. The RWS design is based on passing a simulated roadway beneath an adaptively constrained test vehicle as the vehicle is operated. The simulator will react to steering inputs, acceleration inputs, drive axle torque, braking inputs, and dynamic motion of the test vehicle, while presenting a coherent roadway beneath the vehicle as the equations of motion are satisfied. The associated dynamics of the equivalent real-world test will be simulated, allowing accurate performance measurements to be made.

The RWS will be developed in the following three-phased approach:

- Phase 1a. Finalize design concept.
- Phase 1b. Develop the capability to test two axle, four wheeled military and commercial vehicles (Classes 1 and 4) from 5,000 to 26,000 pounds GVW. No tractor-trailer combinations.
- Phase 2. Expand Phase 1 capability to include testing two and three-axle vehicles up to 60,000 pound GVW, (3-axles meaning 1 single front axle and a tandem rear axle assembly). No tractor-trailer combinations.

- Phase 3. Expand Phase 2 capability to include testing tractor-trailer combinations up to 80,000 pound Gross Combined Vehicle Weight (GCVW).

Benefits

The RWS will provide a key land combat test and evaluation capability that will ensure the achievement of mobility goals described in Joint Vision 2010. It will support testing of advanced-mobility vehicles and other tactical vehicles in a laboratory environment. By capitalizing on the benefits of modeling and simulation, the RWS will revolutionize the testing and evaluation of land vehicles, and will stimulate the SBA concept. The introduction of the RWS as a T&E asset will allow testing to be integrated earlier in vehicle development, minimize design and re-engineering costs, extend test envelopes, extend analysis, ensure data repeatability, and reduce test costs.

Progress & Completion

The RWS project is leveraging the requirements definition and design recommendations resulting from a RWS Test Technology Demonstration and Development (TTD&D) study completed in FY 98. The Phase 1a contract was awarded in September 1999. The expected completion date is December 2000. The Phase 2b contract was awarded in March 2000 with an expected completion and Initial Operational Capability of May 2002. The Ground Breaking Ceremony was held on 25 September 2000. It is anticipated that the Ribbon Cutting Ceremony for the new facility will be held in March 2002.

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Milestones	FY01				FY02				FY03				FY04			
Requirements Approval																
RFP Prep/Solicitation																
Contract Award/Performace	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Light Trucks (Phase I)							x									
Heavy Trucks (Phase II)										x						
Tractor/Trailer Combinations (Phase III)														x		

Threat Simulator Development Project

The Threat Systems Project is a unique JIM Project designed to complement the responsibilities of the Office of the Director, Operational Test and Evaluation to ensure that accurate, cost-effective representations of threat systems are used to support test programs. The project comprises subprojects, generally one year in length, which address shortfalls in threat system representations.

Requirement

The Threat Systems Project is managed and coordinated by the DOT&E Threat Systems Office (TSO) and devoted to the identification and application of new technology to improve threat representation. In addressing future capabilities, Threat Systems subprojects provide unique support efforts to investigate and demonstrate advanced technologies expected in future threat systems. These investments solve limitations in threat representations and are essential for maintaining credible developmental testing & operational testing capabilities.

Description

The Threat Systems Project provides tools to exchange the latest scientific and technological information between the test and evaluation and intelligence communities, and demonstrate technologies for future use in threat representations. This JIM project will complete execution of the following eleven subprojects in FY01:

- Real-Time Dual-Band Electro-optic/Infrared Threat Detailed Scene Convolver
- Flyout Model Upgrade, Advanced Radio Frequency Surface –to-Air-Missile
- Digital Infrared Seeker & Missile Simulation
- Broadband Tactical Laser Illuminator
- UV Stimulator Evaluation and Data Analysis
- K-2000 Signals Visualization Software
- Directed Energy Effects Test and Evaluation Capability
- Enhanced Integrated Air Defense System Messaging in a Simulation/Stimulation Environment
- High Fidelity Mission Level Integrated Air Defense System Representation
- Joint Modeling and Simulation System Threat Model Upgrade
- Environment Characterization for Integrated Training & Evaluation

Benefits

These subprojects promoted common solutions to Service threat representation needs and benefited all the Services by:

- Conducting technical investigations of foreign capabilities leading to development of threat representation resources;
- Identifying, demonstrating, and applying new technologies to improve threat representations;
- Facilitating the exchange of the latest scientific and technical information between the Intelligence, T&E, and Training communities; and
- Integrating new technology and updated threat information in DoD threat representations.

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Transportable Range Augmentation and Control System (TRACS)

The TRACS project is developing a suite of transportable equipment and instrumentation to perform common range control functions. This suite will augment existing test ranges during peak requirements for supporting DoD programs such as ballistic missile defense programs during multiple, simultaneous engagements.

Requirement

In order to conduct developmental and operational flight test and evaluation of DoD systems, a transportable suite of instrumentation is required to augment test support capabilities at existing DoD ranges and to provide capabilities at ranges and/or remote test areas that have little or no basic instrumentation infrastructure. A system is needed to satisfy multi-Service range support requirements for Theater Missile Defense and other testing requirements beginning in FY 2000 and beyond at different locations. The tests to be supported will occur at various locations, including very remote sites. Current missile test ranges do not have enough capability in remote areas of the ranges to test the most demanding mission scenarios. An easily transportable mobile system is required for command, control, and communication; integrated range safety; time-space-position information (TSPI) instrumentation; data processing and analysis; and processing of multi-source weapon system sensor information.

Description

TRACS is a self-contained, transportable system designed to support test mission planning, test execution, real-time data collection and processing, mission control and flight safety, post-mission data Analysis, and report generation. In its Initial Operational Capability (IOC) configuration, it provides real-time TSPI, telemetry data, and flight termination capabilities. The TRACS IOC configuration comprises three discrete systems:

- The TRACS Control Van (TCV)
- Two Mobile Telemetry Subsystems (MTS)
- The Flight Termination Subsystem (FTS)

The equipment and instrumentation located in the vans are modular in design and plug and play capable. TRACS components have imbedded interfaces to ensure their compatibility with host test ranges. Its system interfaces will adapt to existing sensors for communication, radar, global positioning system, optics, telemetry trackers, and meteorological data. At Full Operational Capability (FOC), TRACS will have sufficient capacity to support additional Flight Safety Officers, data processing, and data display autonomously from the TRACS Display Van (TDV) in a fully stand-alone system.

Benefits

Downsizing of the DoD infrastructure has made it impractical to modernize, maintain, or sustain test capabilities for infrequent situations of maximum workload and complex scenarios at all potential test locations. DoD can make more efficient use of resources with an “on-demand” capability that supports a test area only when required for live operations or augments certain parts of an existing range capability as needed to accomplish the required testing. TRACS will provide this extra capacity for the ranges during periods of increased testing activity. By developing only one set of easily transportable instrumentation, millions of dollars can be saved by not redundantly investing in the DoD permanent test infrastructure. Also, reuse of recently developed software from other CTEIP programs such as the Smart Munitions Test Suite avoids developmental costs and enhances overall system performance.

Progress & Completion

The TRACS reached IOC in FY99. The TCV, FTS, and MTS units have been fabricated and have successfully completed their acceptance tests. A TDV and additional capability to the TCV will be added in FY01 to achieve FOC configuration. The TDV will give the TRACS an autonomous capability. The TRACS developmental schedule for FY01 will ensure that the Ballistic Missile

Defense Organization ballistic missile programs will be supported. The different subsystems of TRACS were used, independently of each other, to support numerous missile tests including Theater high Altitude Air Defense, Patriot Advanced Capability-3 (PAC-3) Patriot, Army Tactical Missile System, SM-2 and Black-Brant. The IOC system configuration is currently being used at Fort Wingate, NM, to track targets being launched from northwest NM towards White Sands Missile Range in support of the PAC-3 missile defense program. The TRACS will support testing of the Air Force's Advanced Medium Range Air-to-Air Missile Foreign Military Sales program in Iwo Jima, Japan in March 2001. The TRACS will then be deployed to Pacific Missile Range Facility during FY02 and FY03 to support the Navy Area Theater Ballistic Missile Defense program. It will provide a telemetry based flight safety service for Short Range Air Launch Targets (SRALT) during testing exercises off the Barking Sands Range, Kauai, HI. During the Navy Area tests, all TRACS equipment will be housed on a shipboard platform several hundred kilometers off shore from the Barking Sands range and will provide both telemetry data and flight termination support for the SRALT missile targets.

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Milestones	FY01				FY02				FY03				FY04			
Design	x	x	x													
Critical Design Review				x												
Fabricate Install Integrate					x	x	x	x								
System Test									x	x	x	x				
IOC													x			
FOC														x		

Tri-Service Signature Measurement and Database Systems (TSMADS)

The TSMADS will provide the capability to characterize the detailed spatial, spectral, and temporal signatures of aircraft, missiles, ground vehicles, ships, undersea vehicles, and their countermeasures in realistic environments. Data from these systems will be used to validate modeling and simulations, develop weapon system algorithms, and most importantly, to increase the survivability of the warfighter. The TSMADS systems will be mobile and capable of operation at any location worldwide.

Requirement

Weapon systems technology is advancing at an alarming rate. Seekers are becoming smarter and assets (e.g., aircraft, ships, tanks, and missiles, etc.) both blue and red, are becoming more difficult to detect. In order to support testing of these advanced systems, new, more advanced signature measurement systems are required. The development of future weapon systems, threat simulators, and targets, which depends on test target and threat signature data as input to modeling and simulation (M&S) and hardware-in-the-loop simulation, cannot be properly accomplished without accurate, high-resolution signature data. One cannot adequately predict the capabilities and limitations of a particular weapon system against a particular threat without the capability to validate the test process during test and evaluation (T&E). Powerful M&S techniques have little value in T&E unless the target signature data is available for validation. Weapon system effectiveness will be severely reduced without these advanced capabilities.

Description

TSMADS will develop four signature measurement systems:

- Air-to-Air Signature Measurement System (AASMS)
- Air-to-Ground Signature Measurement System (AGSMS)
- Ground Signature Measurement System (GSMS)
- Acoustic Signature Measurement and Unaugmented Tracking System (ASMUTS)

These capabilities will be developed to achieve maximum commonality. Once these capabilities are integrated into the test infrastructure, they will be available for testing worldwide. Signature data collected from these capabilities will be archived in the National Threat/Target Signature Data System (NTSDS) for future use.

Benefits

The primary benefit of the TSMADS project will be the development of an advanced capability to measure signatures, which will increase survivability of U.S. weapon systems. Payback for the capabilities TSMADS develops will be assessed in the form of value added to the successful developmental and operational T&E of present and future weapon systems. Benefits will include reduced development risks, lower acquisition costs, enhanced operational tactics, improved deception, improved countermeasures and techniques of defeating countermeasures, and reduced vulnerability to threats. TSMADS components' scan rates, spatial/spectral resolution, detection thresholds, and tracking abilities will support all phases of the acquisition cycle and help ensure the most capable and secure weapon systems are added to the inventory.

TSMADS will promote significant development cost savings through joint development, commonality, and interoperability. Another benefit of the TSMADS development will be the ability to move signature measurement systems to any location to support the collection of signature measurement data. Manpower and cost savings will also be achieved in providing signature data in common formats with ease of data retrieval through coordination with the Range Commanders Council Database and NTSDS.

Progress & Completion

In FY98 TSMADS awarded a contract for the development of a high-scan rate, high-spectral resolution airborne spatial/spectral infrared radiometer. This development is based upon a successful TTD&D project which was completed in 1995, the Infrared Imaging Spectrometer (IRIS), and is scheduled for delivery early in FY01. TSMADS also began an in-house development with Arnold Engineering Development Center to design a spatial/spectral ultraviolet radiometer. The spatial/spectral ultraviolet radiometer is also scheduled for delivery early in FY01. Both of these systems are part of the AASMS. During FY99, as part of the ASMUTS development, TSMADS awarded a contract for an Acoustic Signature and Telemetry System (ASATS). ASATS is based on a TTD&D project that was completed in 1998, the Joint Acoustic Signature Measurement. Using this specification, TSMADS generated a Request for Proposals. ASATS was delivered in November 2000. The development of the Air-to-Ground and Ground Signature Measurement Systems began in FY00 with the generation of a specification for these systems. The GSMS and AGSMS consist of electro-optic, infrared, and millimeter wave components. Design efforts in FY00 concentrated on the visible and near infrared ground components. In FY01, design/fabrication of all components of the GSMS and AGSMS will be initiated.

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Milestones	FY01				FY02			
AASMS/SARIS								
IOC/FOC	x							
AASMS/UV								
IOC/FOC	x							
AASMS								
Integration/Test	x	x						
IOC/FOC		x						
ASATS (In-Water Sensor Suite)								
Prototype Construction	x							
IOC/FOC	x							
Signal Process/Algorithmn Dev								
Development	x							
ASMUTS								
Integration/Test	x	x						
Operational Acceptance Test		x	x					
IOC/FOC				x				
AGSMS/GSMS								
Prototype Construction	x	x	x	x	x	x	x	
Part I IOC								x
Part II IOC								x
FOC								x

NEW STARTS

Advanced Instrumentation Data and Control System (AIDACS)

AIDACS is the response to a requirement to correct specific deficiencies in the dynamic testing needs of weapon systems across all Services.

Requirement

The Department of Defense (DoD) has a critical need to conduct developmental testing of aircraft, engines, and missiles (and related subsystems) at simulated altitude and flight conditions. The multi-Service customers' requirements are as follows:

- Real-time processing and access to data for rapid decision making in order to significantly reduce programmatic risk in cost, schedule, and performance.

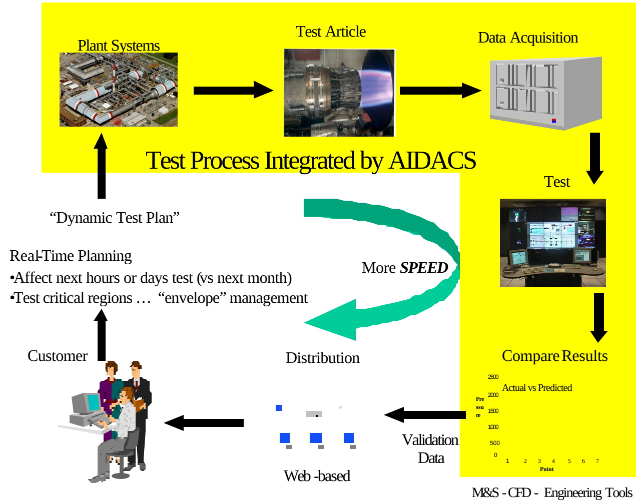
- Advanced test techniques and capabilities to provide significantly more needed risk reduction data for flight assets with dynamic multi-surface and control systems with expanded maneuvering regimes.

These requirements result from deficiencies inherent in current capabilities, such as insufficient performance characterization during mission profile testing, engine/air vehicle integration, and weapons separation of complex systems. The result is increasingly higher risk to cost, schedule, and technical performance of high-tech weapons system programs slated for 2005-2010 due to inadequate ground test facilities now using 1970's vintage instrumentation and control systems.

Description

Located at the Arnold Engineering Development Center (AEDC), AIDACS will address the identified deficiencies by dramatically reducing overall cost and risk to joint and multi-Service/Agency customers by "flying the test article" through mission profiles under varying test cell conditions, a capability which does not exist today. AIDACS will:

- Couple new, sophisticated simulated environment controls, test article positioning, and data acquisition and processing systems;
- Provide required data accuracy, enabling increased performance across many missions;
- Deliver the data remotely to the weapon system developer in near real-time;
- Fuse computational fluid dynamics (CFD) codes



with empirical test cell data in near real-time; and

- Add new instrumentation technologies such as non-intrusive surface pressure measurement, temperature sensors, and on-board pressure measurement systems.

AIDACS will develop state-of-the-art controls for all plant and test operations equipment to automatically set, adjust, and maintain tunnel conditions at set-points commanded by the test matrix sequencer to support Fly-The-Mission Testing. The project will also develop a test supervision system to ensure proper coordination of plant and test operations systems in producing and maintaining desired tunnel conditions to support Fly-The-Mission Testing. Automated techniques to validate data in real-time will be developed to help ensure the integrity of test data as it is acquired. Tools will be provided that fuse real-time data, archived data, previous or concurrent computational models, and/or flight data and distribute validated, real-time data to the test operators at AEDC as well as to the customer's home test site and other remote sites, as required.

Benefits

AIDACS will permit multi-Service customers to obtain high volume data with accuracy, thus reducing program risk at a significantly reduced cost. Weapon system developers will get data remotely in a near real-time to aid in analysis and decision making regarding ongoing tests, resulting in reduced design cycles. Fusing CFD codes with empirical test cell data in near real-time will give superior insight into performance characterization and reduce the risk of undiscovered anomalies appearing in flight.

Overall program development time will be reduced with an estimated savings to some multi-Service programs of $2M to $5M a day.

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Milestones	FY01				FY02				FY03				FY04				FY05				FY06				FY07			
Design	x	x	x	x	x	x	x	x	x	x	x	x	x	x														
Critical Design Review						x			x			x			x													
Fabricate Install Integrate									x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				
System Test													x	x	x	x	x	x	x	x	x	x	x	x	x	x		
IOC																								x				
FOC																											x	

Digital Video Laboratory (DVL)

The objective of DVL is to develop and deliver digital video software and hardware tools to generate, archive, retrieve, and analyze digital video data.

Requirement

Despite the significant advances in digital technology, there is a widely recognized lack of digital video technology tools and methods for effectively analyzing, accessing, and transferring digital video data. DVL is a one year pilot project that will address this short fall in managing the digital data volume and rates demanded the by the test and evaluation of modern weapon systems. The effort will focus on airframe store certification and will also provide a technical background for follow-on digital video initiatives.

Description

A two-phased approach is planned. Phase 1 will:

- Analyze the process and identify areas that can be enhanced by the insertion of digital techniques and tools; and
- Provide a feasibility study with recommendations and a preliminary cost benefit analysis.

Phase II will:

- Implement the most cost effective recommendations into the DoD Airframe/store Compatibility process (Air Force, Navy and Army); and
- Evaluate applicability to other T&E efforts.

Benefits

DVL will:

- Convert test data to digital format and archive these data in a digital library;
- Obtain existing digital video software tools to analyze digital video test data;
- Combine library, tools, and data transfer capability to establish a Digital Video Laboratory which could be used by the DoD community to retrieve and analyze test data; and
- Leverage prototype digital video tools for other test applications.

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Milestones	**FY01**				**FY02**			
Phase I								
Feasibility Study		X						
Cost/Benefit Anal.			X					
Phase II								
Implement Recom.				X	X			
Eval & Recom.					X			
IOC						X		
FOC							X	

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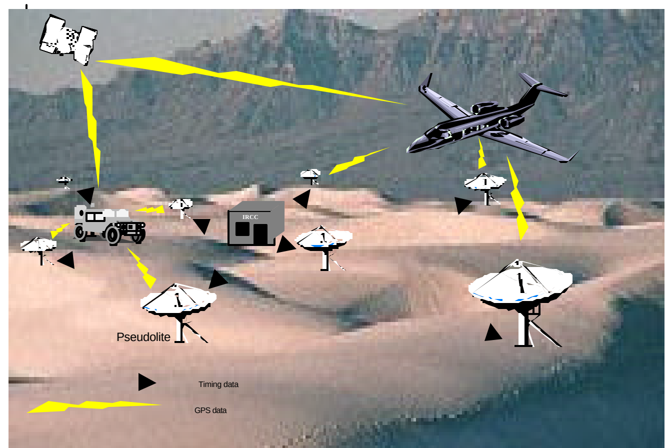
Global Positioning System Signal Validation (GPS-SV)

This project provides a capability to test the modernized GPS signals in a field environment prior to launching new modernized GPS satellites. The first tests will verify backwards compatibility of the new GPS signals with legacy GPS receivers, and later tests will evaluate the performance of modernized GPS receivers and Navigation Warfare (NAVWAR) concepts of operation. The solution envisioned is to design, develop, and deploy an Inverted GPS Range, which is essentially a ground-based constellation of simulated GPS satellites.

Requirement

On March 26, 1996, a Presidential Decision Directive (PDD) was issued stating that the military will need to develop measures to prevent hostile use of GPS and its augmentations to ensure a military advantage without unduly disrupting or degrading civil uses, and encourage the use of GPS in civil and scientific applications. To meet these requirements, the basic signal structure of GPS will change. Four new GPS signals will be added to the existing three. Fundamental changes to GPS satellites and GPS user equipment (GPS receivers) will occur, and the DoD must be able to evaluate the new signals and equipment before they are bought and fielded. In particular, compatibility of the new signals with existing GPS equipment must be demonstrated well before the first launch of a modernized GPS satellite that uses the new signals. Later testing using the new signal structure will verify the performance of modernized GPS receivers that are equipped to take full advantage of the new signals.

There is some urgency to this effort since the first GPS Block IIF satellite launch is currently scheduled for FY06, and any problems with the new signals must be found before satellite designs are frozen. This means the Inverted Range testing has to begin in FY03 and continue through FY05 to ensure that satellites will have usable signals when they are launched. Not only do the new signals have to be usable by new receivers, but the signals must also not degrade or interfere with the existing signals used by current military and civilian receivers. Without the Inverted Range, the new modernized signals would move directly from laboratory testing to on-orbit testing, without adequate developmental testing. This leap is extremely risky due to the widespread reliance of U.S. combat forces on GPS.



Description

A realistic field test environment will be created for testing the use of the new signals with existing and future GPS receivers. The new signals will be generated and broadcast by transmitters that replicate the new signal structure, especially in terms of the manner of spreading the new GPS signal across the frequency spectrum.

The environment will duplicate as closely as possible the operational environment, including the effects of:

- Antenna gain patterns;
- Internal antenna effects such as reflections;
- Aircraft body masking;
- Multipath; and
- Atmosphere.

The test capability will allow for interoperability with NAVWAR prevention assets (i.e., GPS jammers) to create an integrated electromagnetic signal environment.

Benefits

Adequate developmental testing of the structure of the modernized GPS signal will be possible. Backward compatibility of the signal with legacy receivers will be assured as will the optimum performance of new signal receivers.

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Milestones	FY01				FY02				FY03			
Develop TCRD	x											
TCRD approval	x											
Market Research & Risk Analysis	x											
Source Selection		x										
Critical Design Review		x										
Hardware Procurement			x	x	x	x	x	x				
Installation, Checkout, Calibration									x			
IOC										x		
Analysis and Reporting										x		
FOC											x	

Joint Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (JC4ISR)

Joint C4ISR is designed to develop and deploy a test capability that enables system-of-systems and mission level testing of C4ISR systems, certification of the interoperability of information systems and operational effectiveness in the joint integrated/netted battlespace. Joint C4ISR is envisioned to support C4ISR interoperability testing of new and legacy systems and to identify battlespace interoperability problems before a new capability or Family-of-Systems is introduced to the warfighter.

Requirement

Joint C4ISR comprises four integrated product lines that will enable the construction of a Synthetic Battlespace Environment via a distributed testing Federation consisting of disparate sites (Federates), providing system simulation or live entities. Joint C4ISR is envisioned to link the country's major ranges and test facilities with the major C4ISR facilities using a common architecture, standards, and tools. Joint C4ISR will closely follow and leverage the concepts and products of the Foundations Initiative 2010 (FI 2010) project and will be designed to offer a flexible blend of these components as required to satisfy specific test objectives.

Joint C4ISR will support C4ISR interoperability testing of new or legacy systems and Networks-of-Systems from concept development through developmental testing, operational testing, interoperability testing, and interoperability certification. At each of the test phases of a program's life cycle, verification or certification is required when different and sometimes complex objectives are being met. Designed to offer a flexible and re-configurable System-of-Systems test environment that can be employed to validate system level performance at the early life cycle phases, Joint C4ISR will provide for an operationally representative battlespace for assessments at the battlespace (system-of-systems) level.

As a program matures through its lifecycle, various modifications, updates or enhancements are inevitable, forcing the program, and its associated Family-of-Systems, to cycle through the test phases. This spiral development dictates that program managers seek retest and re-certification test venues to ensure compliance with the system requirements, as well as to validate interoperability with related systems. Joint C4ISR will be designed as an efficient solution to facilitate the retest and re-certification process.

Description

The Joint C4ISR Project Team is led by the Navy and Joint Interoperability Test Command (JITC). Joint C4ISR products are designed for use by all Services and Agencies engaged in C4ISR interoperability testing. The four product lines of Joint C4ISR are:

- Joint Test Federation. Interfaced T&E facilities/ ranges, C4ISR Tactical Systems, and Test Resources in an interoperable, reconfigurable software environment compliant with the Test & Training Enabling Architecture (TENA), using the TENA Object Model, which provides compliancy with the High Level Architecture;

- C4ISR Distributed Test Suite. Development and upgrade of selected C4ISR test software and hardware resources enabling the transport and collection of tactical C4ISR data in complex distributed C4ISR test events;

- C4ISR Application Tools Suite. Plug-in extensions and additions to the FI 2010 Tool Sets (as required) providing integrated applications for the planning, execution, data analysis and performance reporting of joint C4ISR test, training, and experimentation events; and

- C4ISR Mobile/Integrated Instrumentation System. Transportable C4ISR Test Control Center and integrated-modularized instrumentation suite designed to capture C4ISR data from a mobile portal that has connectivity between the C4ISR test federation, C4ISR distributed test suite and the test or experimentation Site. Will include a core set of C4ISR link capabilities and reconfigurable instrumentation based upon specific test objectives.

Benefits

Joint C4ISR provides the capability to create a Joint Synthetic Battlespace Environment consisting of live and virtual elements, including the Joint Tactical and Strategic C4ISR Networks. The project will further develop and employ universally applied methodologies; criteria; and applications for the planning, execution, analysis and reporting of Interoperability Tests. The guiding goal of the Joint C4ISR project is to reduce the cost, time, and resources required to plan and execute C4ISR interoperability testing.

With Joint C4ISR, technical deficiencies may be identified early in the development of a system by inserting analytical models and simulations in a realistic battlespace environment. Likewise, Joint C4ISR may expose technical and operational problems prior to deployment by including live systems, networks, operators, and decision-makers in a controlled battlespace environment. In the more operationally representative test environment, virtual prototypes embedded in realistic synthetic environments with live participants can aid in developing a shared vision of the proposed system's utility. This provides a means for understanding and assessing the complex interactions among the various battlespace (system-of-systems) components.

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Event	FY01				FY02				FY03				FY04				FY05				FY06				FY07			
CTEIP Phase I																												
Doc Development			X																									
Doc Review				X																								
Doc Approval					X																							
CTEIP Phase II																												
Architecture Development							X						X						X						X			
Product Development																												
> Beta Capability												X																
> IOC Release I																		X										
> Release II																								X				
> FOC Release																												X
Test & Deployment																												
> Capability Demo/Test												X						X						X				
> Combined Test Events																									X			X
> FOC																												X

Magdalena Ridge Observatory (MRO)

Congress established the 31,000-acre Langmuir Research Site in the Cibola National Forest, New Mexico in order to encourage scientific research into atmospheric processes and astronomical phenomena and to preserve conditions necessary for that research. Congress found the site uniquely suited for such purposes. It also designated a 1,000-acre principle research facility and authorized and directed the Secretary of Agriculture to enter into an appropriate land use agreement with New Mexico Institute of Mining and Technology (NMIMT). The Army's Space and Missile Defense Command (SMDC) has determined that the principal research facility is an excellent location from which to study missile flights and tests involving White Sands Missile Range (WSMR). NMIMT currently operates a small observatory at this site, which at 10,6000 feet, is the fourth highest and second darkest facility of its kind in the world. SMDC has teamed with the Magdalena Ridge Observatory Consortium (MROC) to design, build, and operate a state-of-the art, research observatory for joint use at the principal research facility.

Requirement

The MRO project will provide a state of the art, high-resolution optical tracking system. Current optical tracking systems are limited in resolution by apertures of less than a meter. To achieve needed resolution of 10 cm at 100 km, a 10-meter aperture is required. Telescopes with apertures of 10 meters currently cost $100 million and are massive, fixed structures. The two 10 meter telescopes in existence are not located to support missile tests, nor are they designed to do so.

Synthetic aperture radar and radio astronomy technologies are maturing, primarily through DoD development efforts. Synthetic aperture radars operating at a gigahertz require internal clocks operating at 100 gigahertz to make phase measurements. For synthetic optical tracking devices, which operate at even higher frequencies, the use of an internal clock is impractical, and a different approach is necessary to keep track of phase. The engineering is only now becoming available to provide alternative phase keeping capabilities and has been demonstrated for small telescopes of 10-meter synthetic apertures. These systems are too small to collect enough light to achieve a good signal to noise ratio with an acceptable resulting image. Higher resolution requires meter-sized optics and synthetic apertures of tens of meters. While a passive system can be built to do this, it can only operate in a vacuum. The atmospheric phase distortion of the optical wavefront over the aperture of a meter class telescope will prevent coherent addition of signals and thus limit the resolution to that of a single telescope. In the future, adaptive optics may correct for atmospheric distortion and thus allow the coherent addition of images needed for synthetic optical resolution.

Description

The project will design, fabricate, and test an operational high-resolution missile tracking testbed. Using state of the art interferometric technology and adaptive optics, data from the optical tracking system will be used to create high-resolution images of a quality not achievable by any single terrestrial telescope. The program will also serve as a testbed for future lightweight mobile systems that can be deployed worldwide. The program will also support DoD research and development optical testing and serve as an observatory for a consortium of universities, on a non-interference basis. Three 2.4-meter telescope systems will be developed and installed in a synthetic aperture array at the site, along with the necessary interferometer optics, in a unique testbed assembly. To maximize use of this testbed, all the facilities and support equipment will be installed for day/night, year round operation by both DoD and the universities. At the completion of the development, a fully operational missile tracking system will be operated and maintained by the university consortium.

Benefits

The MRO project, when fully developed, will be the most advanced single high-resolution missile tracking system in the world, providing heretofore unattainable capabilities in monitoring missile flight data. State of the art technologies developed in this program will facilitate advances in Space and Missile Defense programs as well as enhance capabilities at WSMR. The facility will also provide research and testing opportunities for other DoD customers. Finally, the unique partnership with other members of the consortium will provide a world-class research observatory and test support facility capable of supporting university research.

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Milestones	FY01				FY02				FY03				FY04			
Design	x															
Facilities/Admin Buildings	x	x	x	x	x	x	x	x	x							
Fabricate Install Integrate Mirrors	x	x	x	x	x	x										
System Test					x	x	x	x	x	x	x	x				
Telescope 1 Operational									x							
Telescope 2 Operational											x					
Telescope 3 Operational													x			
Benefical Occupancy Date													x			
Interferometer Operational															x	

Silent Sentry (SS2)

A new technology, Passive Coherent Location (PCL), has the potential to locate and track airborne targets using phased array antennas to receive reflected low frequency Radio Frequency (RF) radiated signals from commercial television and radio stations.

Requirement

The Department of Defense (DoD) has a need to develop a test bed capability to test and evaluate the PCL technology. The capability to detect, acquire, and track targets is needed to assess the maturity of PCL technology and also assess its relevance in a military environment. White Sands Missile Range (WSMR) currently does not have the capability to evaluate and test the PCL technology.

Description

SS2 project will develop a test bed at WSMR to test and evaluate the ability of PCL technology to detect, acquire track, and provide Time, Space, Position Information data on airborne objects. The testing envelope will also include testing the PCL technology capabilities to track targets, assessing vulnerability and immunity to ECM, and assess its ability to track low altitude object in mountainous terrain and generate of Radar Cross Section in the low frequencies range.

The major components for operation of the SS2 include the antenna array, receivers, a massive processing capability, and existing commercial TV and radio stations. A commercially developed system has successfully been tested on tracking the Space Shuttle.

Radar instrumentation and Global Positioning System (GPS) devices at WSMR will be used to provide accurate ground truth data on “targets of opportunity.”

Benefits

If proven effective, the PCL project will provide benefits throughout the range instrumentation arena. The Phase I project will include the development of the test bed capability to test and evaluate PCL technology. Direct benefits to be provided include expanded capabilities to test and evaluate and increased safety to the warfighter by providing threat assessment. The test bed will be developed for the DoD, based on the functional requirements to test five areas of PCL technology:

- Capability to perform radar instrumentation, including target acquisition and tracking;
- Vulnerability assessment;
- ECM effectiveness experiments;
- Intelligence; and
- Radar cross section generation and analysis.

Project Director:

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Milestones	FY01				FY02				FY03				FY04			
Design	x	x	x													
WSMR Augmentation Plan																
SS3 Site Selection																
Facility Requirements			x													
Firm Power			x													
Commo			x													
Data Network			x													
User Requirements		x	x													
LM Provides Spt Rqmts		x														
Support Instrumentation			x													
Graphics (RTDS Upgrd)				x												
Complete WSMR Infastructure				x												
Critical Design Review				x												
Fabricate SS3					x	x	x	x								
Install & Integrate @ WSMR								x								
System Test									x	x	x	x				
Test SS3 at WSMR										x	x					
Test SS3 at NRTF											x					
SS3 IOC													x			
SS3 FOC														x		

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Resource Enhancement Project

- Electromagnetic Order of Battle - Environment Generator System
- Geometric Automated Video Enhanced Location System
- Geometric Pairing
- Instrumentation of the IBIS Hammer System
- Joint OT&E Simulation Environment Facility
- Radio Frequency Phase Distribution Upgrade
- Real Time SAM Models for OT&E
- Shallow Water Anti-Submarine Warfare Target
- TAMD Interoperability Assessment Capability
- Weapons Analysis Facility Enhancement Resource

NEW STARTS

- Countermeasure Threat Emulator
- Information Assurance Suite
- National Air Intelligence Center Air-to-Air Threat Models
- Portable Joint Link - 16 Monitoring Capability
- SA-XX Modification
- Theater Battle Management Core System and Deliberate and Crisis Action Planning and Execution Segments Command and Control Test Capability
- XM-11S Priority Upgrades

The Resource Enhancement Project (REP) is funded under the CTEIP to provide quick reaction, near-term solutions to operational test shortfalls in support of ongoing system acquisition or product improvement programs. The need for the specific capability is generally not known more than 3 years in advance of the operational test requirement. The Director, Operational Test and Evaluation (DOT&E), Service, and DoD Agency involvement in REP subproject identification, selection, and execution oversight ensure optimal utilization of the developed or acquired capability and melding with the DoD test and evaluation investment strategy.

For additional information contact Ms. Suzanne Strohl, the REP Project Manager at (703) 578-8222, e-mail sstrohl@dote.osd.mil

Electromagnetic Order of Battle - Environment Generator System (EOB-EGS)

Marine Corps Lead

Requirement

The Marine Corps does not have a test site with the capability to simulate the dense electronic environ ment or the specific EOB associated with the areas of operation in which Marine Corps systems currently under development are most likely to be employed. The requirement for a system to produce a representative threat environment creates the need for the EOB-EGS for use in the Operational Test and Evaluation (OT&E) of the Mobile Electronic Warfare Support System (MEWSS) Product Improvement Program (PIP). Additionally the EOB-EGS will be used in the OT&E of the Team Portable Collection System (TPCS) Upgrade, and FOT&E of the Technical Control and Analysis Center (TCAC) - PIP. These systems are significant participants in the conduct of Marine Corps Command and Control and ground electronic warfare operations.

Description

The EOB-EGS will be a scenario and signal generator developed to simulate and/or replicate friendly and threat electronic environments that will be encountered by the MEWSS PIP, the TPCS Upgrade, and the TCAC - PIP. The system will also have the capability to collect and analyze data to provide information regarding the effectiveness of the MEWSS, TPCS, and TCAC-PIP in functioning in operationally realistic scenarios. EOB-EGS will use scenarios that will define timelines of emitter signals including signal type, on/off time, frequency, and modulation. FY01 funding will complete all remaining design tasks and fabrication. The EOB-EGS, including a signal verification and data reduction tool, will be tested, validated, and delivered for use in MEWSS operational testing.

Benefits

The EOG-EGS is transportable and can be operated by AC or DC power. This system will provide the capability to generate communications and radar signals for test and training exercises for the Marines Corps. It will create signal density for multiple signals to stimulate various ELINT, COMINT, and SIGINT systems. EOB-EGS will enable the Marine Corps to fully test, evaluate, and report in quantifiable terms on the operational effectiveness of the functionality of MEWSS-PIP, TPCS (Upgrade), or TCAC-PIP.

Geometric Automated Video Enhanced Location System (GAVELS)

Army Lead

Requirement

Fire Support Tests are often limited to inaccurate measurements of impact or fuze function location events. Airborne decent rates, time of stabilization, and dispersion data accuracy is unacceptable with current Army instrumentation. The Army does not have instrumentation that measures and collects density, dispersion, velocity, range, and accuracy data for subsonic projectiles. In order to correctly answer operational issues, fire support system accuracy or other measurements must be precise. GAVELS will provide this level of precision.

Description

GAVELS will provide remote controlled event detection, video link and wave let image compression, precision gimbal and local video links, high-speed cameras, and a mobile platform. GAVELS will be used primarily to locate artillery round and functions in Universal Transverse Mercator coordinates and altitude. The system consists of an Event Recording Subsystem (ERS) and a Photogrammetrical Analytical Reduction Translation Subsystem (PARTS). A typical GAVELS employment will use four ERS camera stations. The ERS records and codes events with video bar coding. The bar coding is edge coded directly on the video and contains vital information such as GPS time and event number. PARTS uses the edge coded information from the camera sites and will associate them together, with GPS time as the common attribute.

This subproject will redesign and ruggedize the current GAVELS hardware, fabricate the wireless remote control and video monitoring capability, develop the video compression/decompression hardware and software for the field data collection units, develop the software for signal processing, and provide a real time central control station.

Benefits

GAVELS will provide:

- X, Y, and Z data with a 1 meter accuracy;
- Frame grabbing that eliminates "jitter" inaccuracy;
- Encoded mission information that provides data integrity and self-documentation;
- On-screen co-windowing of video and statistical information (e.g. mission number, coordinates, etc.)

- On-screen, real-world plot portrayals (2-D and 3-D);
- Co-windowed video zoom for event scoring;
- Automated centroiding of scoring indicator;
- Co-windowed, time-synched separate camera views; and
- User-friendly output statistics and plotting.

GAVELS enhancements will provide faster turn around of data in the camera/reference site realignment process, faster compilation of data for data authentication groups, and enable simultaneous tracking of multiple targets. These capabilities will allow the conduct of operational testing for munitions/airdrop systems and non-lethal weapons systems.

GAVELS supported the Search and Destroy Armor (SADARM) testing in 2000 at Yuma Proving Ground. The scoring of the SADARM submunition functions in the air was highly successful and accuracy of less than 1 meter error was attained in coordinates and altitude. GAVELS also supported the operational testing of the Bradley Fire Support Vehicle/Striker that year at Fort Stewart, GA. Despite the physical constraints of the Artillery Impact Area, GAVELS determined the locations of the larger targets in the limited overlap of coverage area. The locations of smaller targets were also discerned. Testing of the Brilliant Anti Tank at White Sands Missile Range in June 2000 was also supported.

GAVELS will also support testing of the Army Tactical Missile System, Crusader, Airborne Special Operations Advanced Tactical Assault Parachute, and participate in further SADARM testing.

Geometric Pairing (GEOPAIR)

Army Lead

Requirement

At the present time, the Mobile Automated Instrumentation Suite (MAIS) pairing laser is limited to a maximum range of six kilometers due to eye safety problems. This will not allow the Real Time Casualty Assessment (RTCA) testing of rotary wing and fixed wing aircraft at ranges beyond six kilometers. There is currently no method to accurately portray the air defense weapon systems that will be used against the Comanche aircraft. In view of this, a study was conducted to analyze the alternative methods of accomplishing RTCA. Several methods were derived that would provide the accuracy required for high fidelity testing using a combination of systems (Global Positioning System (GPS), laser gyro, magnetic compass, etc.). This subproject will integrate these technologies into a prototype that will be mounted on an aircraft to measure performance for long range air to ground combat.

Description

This subproject will design and develop a Geometric Pairing (Pointing) device to be used with air defense weapons against aircraft during RTCA testing of the Comanche. This system will use GPS interferometers, magnetic compass, and a laser gyro. It will use target/firer location, firer ammunition, and pointing vector information to enable the target to calculate impact. Commercial-off-the-shelf devices will be used to measure azimuth and elevation. Software will be written for interfacing to small arms kits, and a database for small arms engagements will be developed. Software will also be written to support pairing data requirements, and an algorithm for interfacing with the aircraft bus will be developed. This subproject will build three prototype units.

Benefits

GEOPAIR will enable the conduct of RTCA engagements at ranges that are equal to the ranges of the threat weapons. This capability will enable RTCA engagements in an obscured environment (fog, dust, etc.) and determine effectiveness, suitability, and survivability of system under test. It will provide more realistic simulations through more accurate trajectories.

Instrumentation of the IBIS Hammer System (IBIS Hammer)

Navy Lead

Requirement

A complex mix of multiple threat systems is required to test advanced, integrated EW systems. Currently, the Navy is unable to address weapons/aircraft survivability and the effectiveness on/off-board Electromagnetic Countermeasures against advanced short and medium range threats in multiple target engagements. The operational effectiveness of systems cannot be evaluated against simultaneous command guided (pulse doppler), semiactive continuous wave, semiactive/ground aided (pulse doppler), and command guided (pulse) radar and missile functions.

Description

The IBIS Hammer is a technically advanced foreign Surface-to-Air Missile (SAM) system. The system is mobile and uses a medium range SAM to defend ground forces from aerial attack by fixed and rotary wing aircraft. It has an integrated local frequency scanned Target Acquisition Radar and Phased Array Engagement Radar that can track two targets simultaneously. The IBIS Hammer subproject will instrument actual threats radars listed as critical threat by the Integrated Defensive Electronic Countermeasures (IDECM) and F/A-18 E/F programs. The Air Force is currently developing an instrumentation package to insure common data products between Electronic Combat Range (ECR) and Western Test Range. The Air Force design will be duplicated and the data bus tap will be identical to that of the Air Force system. The Navy will install the instrumentation package on the IBIS Hammer system scheduled for siting at the ECR. Although the final instrumentation and siting will not be completed until September 2001, this subproject is designed to provide an interim capability to support IDECM Block II developmental and operational test events scheduled for the 1st and 3rd quarters of FY01.

Benefits

This subproject will provide an instrumented double digit threat asset to enhance multiple threat environments in support of the testing of EA-6B Improved Capability III, IDECM Radio Frequency Countermeasures, FA-18E/F, and ALE-50 towed decoy programs.

Joint OT&E Simulation Environment Facility (JOSEF)

Defense Information Systems Agency Lead

Requirement

Defense Message System (DMS) tests require at least two organization level configurations that must be able to interoperate remotely. Each configuration will consist of at least 250 users, representative background traffic loading of the Backbone Message Transfer Agents (BMTA), network management, and directory services. Without a simulation capability, each live DMS test requires 500+ operators and still does not provide sufficient backbone loading to address performance critical operational issues (COIs). Global Command and Control System (GCCS) tests require interface traffic from tactical sources. Live sources are not always readily available and do not represent the same truth source to address tactical interface COIs. Controlled, repeatable inputs available for each test from the same battlespace source are required.

Description

The JOSEF is a reusable capability critical to providing a representative operational environment for the operational testing of network centric Command, Control, Communications, Computers, & Intelligence (C41) systems. JOSEF provides stimulations of numerous users, which replaces the need for multiple human operators. It provides a battlespace picture for tracking systems in replacement of live interfacing platforms.

This subproject will develop a simulation of 512 DMS users for repeated testing and will provide message loading for backbone message transfer agents and directory agents. It will provide a traffic loader for BMTA message traffic, a loader to stress network managers workstations, and provide simulated representative tactical communications traffic using existing and new message simulations to represent shipboard and/or field transfer messages. It will use High Level Architecture (HLA) standards and HLA runtime interface (RTI) components that are interoperable with the GCCS and the Air Defense Systems Integrator (ADSI). It will provide a capability to emulate tactical message traffic to load the ADSI and additional tactical traffic for evaluation of the GCCS Common Operational Picture with the RTI.

Benefits

JOSEF will provide the simulation and modeling tools to support operational testing of Joint C4I systems. It will provide the capability to simulate a virtual operational environment, collect and analyze C4I network traffic, and provide data for calibration and validation of constructive models. It will emulate communications traffic that is correlated with the simulated environment and stimulate live systems in operational test networks with emulated communications traffic. It will provide network management traffic under network stressing conditions. These benefits and payoffs apply not only to GCCS and DMS systems but various Joint Service, Commander-in Chief, and Defense Agency programs.

JOSEF supported frequent Y2K tests in fall of 1999 and spring of 2000 by providing a controlled, repeatable battlespace environment both before and after millenium boundaries to highlight deficiencies. The GCCS 3.05 Operational Interoperability tests using JOSEF stimulation was completed in 2000. JOSEF also supported the DMS 2.1 Maintenance Release (MR2) testing using JOSEF

Remote Terminal Emulation (RTE). The DMS 2.1 MR2 retests of the Microsoft user agent using JOSEF RTE were completed, and JOSEF supported testing of DMS version 2.2 and Operational Assessment of DMS 2.2.

Radio Frequency Phase Distribution Upgrade (RF-PDU)

Navy Lead

Requirement

The testing of Electronic Support/Electronic Attack (ES/EA) systems under the full scope of tactically relevant electronic environments can not be completed because many recently developed high priority threat systems are not available at open air ranges. In view of this, threat detection, jammer assignment, identification and targeting Critical Operational Issues (COIs) can not be addressed.

The existing Advanced Tactical Electronic Warfare Environment Simulator (ATEWES) phase Microwave Phase Distribution (MDS) subsystems were designed to interface with the EA-6B Advanced Capability (ADVCAP) receiver front end. However, attempts to reconfigure one system to test the Joint Airborne SIGINT Architecture (JASA) High Band Prototype has revealed that many hardware and software problems must be addressed to meet required EA-GB Improved Capability III (ICAP III) testing. Use of modeling and simulation, coupled with ATEWES Upgrade, will expand the operational test envelope to include a variety of operationally realistic environments.

Description

This subproject will procure ATEWES MDS hardware and develop software subsystems to meet EA-6B ICAP III LR-700 receiver upgrade and planned follow-on interferometer receiver systems test requirements. The ATEWES requires 30 phase paths to support High Band Long Base Interferometer (LBI) apertures for the LR-700. Additionally, ATEWES phase control boards and calibration software will be modified to support the port requirements of the LR-700 system. Substantial reuse of components and commercial-off-the-shelf hardware will be used for this modification. The ATEWES system will be validated using the DoD validation process as appropriate for identified operational test requirements.

Benefits

RF PDU will provide an asset to test interferometer based ES/EA receiver systems in operationally realistic electronic and combat environments. Through the use of the RF PDU, major COIs will be addressed including threat detection, jammer assignment, identification, localization, overall system performance, high-speed anti-radiation missile (harm) targeting, tactics, survivability, joint interoperability, software integration, and Lethal Suppression of Enemy Air Defenses. RF PDU will be ready to support EA-6B ICAP III CTT/OA in August 2001 as an initial operational capability, and the full operational capability will be ready in time to support DT/OT-IIA1 in December 2001.

Real Time SAM Models for Operational Test & Evaluation (RTSAMS)

Air Force Lead

Requirement

The F-22 Air Combat Simulation (ACS) and Joint Striker Fighter (JSF) Virtual Strike Warfare Environ ment (VSWE) modeling and simulation tools require credible surface-to-air missile (SAM) models that run in real time. Current DoD policy requires the intelligence agencies, through the Defense Intelligence Agency, to either develop the models and/or substantiate their credibility. Current Joint Modeling and Simulation System (JMASS) efforts being developed by the Missile and Space Intelligence Center (MSIC) do not support real time execution.

Description

This subproject will develop and provide eight real-time surface-to-air missile (RTSAM) models required for virtual simulations being developed for the F-22 and JSF programs. The F-22 ACS and JSF VSWE simulations provide the capability to evaluate weapon systems in a mission level, realistic combat environment. The RTSAM subanalytical models are being developed by MSIC and derived from the JMASS98 analytical models. The procurement includes models of the fire control radars, the firing units, and missiles for each of the SAMs. The FY01 funds will complete the verification and validation and ACS integration of the RTSAM models.

Benefits

RTSAMS will provide the F-22 test team with credible tools to evaluate their weapon system and will provide DIA with validated SAM models. These models will evaluate weapon system survivability on Offensive Counter Air missions, such as Force Protection, Fighter Sweep, Suppression of Enemy Air Defenses, etc. RTSAMS will support the ongoing development effort for JSF VSWE virtual simulation. In addition to the F-22 and JSF, the RTSAM models will be used to support the Digital Integrated Air Defense System simulation.

Shallow Water ASW Target (SWAT)

Navy Lead

Requirement

Anti Submarine Warfare (ASW) systems to be employed against shallow water diesel-electric submarines, typical of third world threats, have not been able to address such Critical Operational Issues as bottomed operations, extremely slow, low doppler targets, and targets operating in extremely shallow (<300 feet) water. Existing target submarines and mobile target simulators adequately replicate neither the active and passive signatures nor the tactical and maneuvering characteristics of the current or projected threat.

Description

This subproject will modify the *USS Dolphin* (AGSS-555), an existing, manned diesel-electric research submarine, for use as an ASW target. The vessel will be modified to enable it to conduct bottoming operations and provided with the required structural modifications necessary to be certified for unintentional torpedo impact. It will also be equipped with additional countermeasure (CM) dispensing capabilities. The FY00 REP resources funded the design of the anchoring system and CM launcher, installation of the foundations and openings necessary to accommodate installing the anchoring system and CM launcher systems,assessment and identification of the required safety modifications for unintentional torpedo impact by Mk 48 Advanced Capability (ADCAP) or Mk 50 exercise torpedoes, and the feasibility study of using composite material for the Mk 48 ADCAP shields. FY01 REP funds will be used to complete fabrication and fit check of the CM launcher and bottoming system, initiate the development of the acoustic model, and design the shields.

Benefits

SWAT will provide accurate, full-spectrum target signatures for shallow water environments. It will provide ASW system capabilities to adequately assess and evaluate the effectiveness of lightweight and heavy weight torpedo terminal homing algorithms. The resulting payoff will be a bottoming and countermeasures capable, diesel-electric submarine that is representative of third world threats. SWAT will support the testing of Mk 54 Mod 0 Torpedo, Mk 48 Advanced Capability Torpedo, SH-60R/Airborne Low Frequency Sonar, and Virginia Class Submarine.

TAMD Interoperability Assessment Capability (TIAC)

Defense Information Systems Agency Lead

Requirement

The Family of Systems (FoS) concept is based on the operational need for Theater Air and Missile Defense (TAMD) assets of the various Services to work as an integrated family. This need has only recently been formalized via the Theater Missile Defense Capstone Requirements Document (CRD). The CRD identifies functional capabilities that exceed the sum of the individual Major Defense Acquisition Program (MDAP) capabilities as delineated in their respective Operational Requirements Documents (ORDs). The TIAC is required to analyze how well FoS configurations interoperate across multiple joint networks to support joint TAMD operations. Some developmental testing and MDAP operational tests can help predict shortfalls in interoperability. However, there are no current, joint analytical tools that correlate the multiple systems and data source necessary to draw sound conclusions about interoperability and its effect on TAMD effectiveness.

Description

The TIAC is a deployable asset with the capability to perform collaborative analyses of the interoperability of TAMD FoS. The TIAC will adapt references and fuse instrumentation and tactical system data from multiple sources and provide quantitative and pictorial reporting of key metrics to alert testers to interoperability issues. It will allow testers to query and integrate related missile range, tactical system, and joint network data for detailed investigations of Battle Management and C4I issues that hinder effective TAMD operations. It will support collaborative analysis with Service/DoD Agency components through configurable and exportable outputs. TIAC will provide shelterized and transit case configurations; develop key interface, correlation, and reporting capabilities; and use state of the art analysis tools, application servers, and workstations. The database server and adaptable import server will handle diverse sources of joint data and will provide multi-format results of presentation data.

Benefits

TIAC will be flexible enough to deploy to any test or exercise. Since the basic unit is in transit cases, only the capabilities required for a specific test need to be deployed thus saving on manpower and transportation costs. Its ability to collect data at operational tests, exercises, and special events will reduce the requirements for additional tests to address FoS and MDAP interoperability issues. Cost savings will be significant for tests involving live fire. TIAC will support the testing of Patriot Advanced Capability-3, Navy Area, and TAMD FoS.

Weapons Analysis Facility Enhancement Resource (WAFER)

Navy Lead

Requirement

The capability of advanced Anti-Submarine Warfare (ASW) torpedoes to engage extremely slow, low doppler diesel submarines and submarines operating in extremely shallow (<300 feet) water cannot be fully tested because of the lack of a target to emulate these threats. Therefore, the undersea warfare testers cannot address the fast/deep, bottomed, slow and low doppler critical operational issues found in the Test and Evaluation Master Plans for ASW torpedoes. Additionally, operational test scenarios are limited by peacetime safety rules that limit torpedo and target submarine end-game interaction and restrict target evasion speeds and depths.

Description

The WAF is a real-time, high fidelity, hardware-in-the-loop simulator for Navy undersea weapons and countermeasures (CM) programs. This simulator is used to support analyses of torpedo search, acquisition, and homing and evaluations of terminal end game fuzing against potential threat targets in operationally realistic, synthetic environments that cannot be accomplished through live fire exercises. This subproject will complete the development of threat submarine, surface combatant, and surface launch torpedo models and model interfaces with new hardware and conduct verification and validation upgraded environmental, CM, and threat target models. Additionally, this subproject will procure, integrate, and test simulation hardware, including the core Central Processing Unit (CPU) and high speed networking equipment needed to run the high fidelity models and provide tactically significant warfare scenarios. FY01 funds will be used to complete development of the sonar interference and torpedo salvo models initiated in FY00 and complete the model interface development in support of MK 54 and MK 48 torpedo operational testing.

Benefits

WAFER will provide to capability to simulate threat targets and countermeasures in tactically significant environments. It will provide the capability to test torpedo effectiveness against bottomed or extremely slow, low doppler diesel and will resolve the torpedo end-game issues. The coated diesel target model was used extensively for a sea-based weapons and Advanced Tactics School sponsored tactics development and evaluation study during August and September. Significant use is anticipated in FY01 as the torpedo systems go to operational test. WAFER will support the testing of Mk 54 and Mk 48 Advanced Capability torpedoes.

New Starts

Countermeasure Threat Emulator (CMTE)

Navy Lead

Requirement

Current methodology for testing torpedoes and other assets in a threat countermeasure (CM) environment is to use U.S. CM devices, which are stationary with fixed programmed signals (including fixed structured signals). The use of U.S. devices rather than foreign CM devices diminishes the determination of actual operational effectiveness of the weapon under test and reduces the overall value of the test. Actual threat CMs can be mobile, consist of multiple devices (often in stationary and mobile combinations), and in addition to broadband noise, these devices can have an echo repeat mode and respond in a near adaptive manner. These devices provide a CM environment far different than the acoustic noise that U.S. CMs put into the water.

Description

This subproject will fabricate programmable CM devices to emulate threat CMs that can be launched from submarines via 3-inch signal ejectors or dropped over the side of surface ships. The CMTE will have both a mobile and stationary capability and be programmable prior to launch from a personal computer. It will incorporate programmable signal types including, foreign broadband and structured signals, swept/random low frequency modulation, echo repeat modes, and pink noise. New signal types can be added to the programmable database as needed. FY01 funds will complete system design, electronics development and hardware modifications, initiate electronics and hardware integration, design and fabricate the portable threat CM database interface unit, and build threat emulator software.

Benefits

CMTE will provide realistic scenarios for determining the effectiveness of operational weapon counter-countermeasure software. This capability will provide operational assets for evaluation of current and future Navy tactics against threat countermeasures. It will also provide high quality test scenarios with realistic threat CM environments for the Mk 54 Mod 0 torpedo, the Mk 48 Advanced Capability torpedo, and the Virginia Class submarine programs. CMTE is programmable and would allow future threats and future threat scenarios to be added into the threat CM database.

Information Assurance Suite (IA Suite)
Army Lead

Requirement

With the current emphasis on transition of the Army to the digitized battlefield, the implications of fielding new systems that are susceptible to information warfare have become critical. Information Assurance (IA) testing is a new requirement for all major weapon systems. Currently, there is no existing capability that could support IA testing, which is required for all ACAT I systems.

Description

IA Suite development will procure commercial-off-the-shelf hardware, instrumentation, and systems that can be used to test vulnerability to information warfare techniques. Specifically, instrumentation will be identified to break into radio frequency local area networks, intercept phone numbers and addresses to radio frequency modems, and record and retransmit preambles to become a new user or controller on data links.

Benefits

This subproject will provide the capability to address and answer the critical information warfare issues for future Army battlefield systems. The IA Suite will provide receivers to intercept the signal; equipment to analyze the modulation and protocol, modify the intelligence, and insert the false message on a carrier; and transmitters capable of resending the false message in a proper format. This capability will evaluate system susceptibilities and vulnerabilities to information warfare, which is a new test criterion required on virtually all-new military battlefield systems. IA Suite will be a mobile capability that can be used anywhere. Integration within existing facilities will provide a low cost of operation and maintenance. IA Suite is scheduled to support operational testing of the Tactical Unmanned Aerial Vehicle, Payload, All Source Analysis System blk II, Airborne Standoff Minefield Detection System, Crusader, and Joint Surveillance Target Attack Radar System Common Ground Station.

National Air Intelligence Center (NAIC) Air-to-Air Threat Models (NAIC ATM)
Air Force Lead

Requirement

The F-22 Air Combat Simulation (ACS) and Joint Strike Fighter (JSF) Virtual Strike Warfare Environment (VSWE) modeling and simulation tools require credible, threat air combat models that run in real-time. Current DoD guidelines and policy requires the intelligence agencies, through the Defense Intelligence Agency (DIA), to either develop threat models and/or substantiate their credibility. However, due to reduced funding and changes in NAIC policy on validating legacy threat models, the NAIC infrastructure can not support the F-22 ACS and JSF VSWE modeling and simulation test requirements.

Description

This subproject will provide four real-time air combat threat models required for virtual simulations being developed for the F-22 and JSF test programs. The F-22 ACS and JSF VSWE simulator provide the capability to evaluate weapon systems in a mission level, realistic combat environment during operational; testing. Phase I of this subproject includes requirements definition, design, and development of code from which the ACS software engineers and other users will develop either C++ or ADA 95 code. Phase II will translate the visual models into actual executable C++ code to complete the fully functional and validated threat models. Models of the radars, fire controls, aerodynamics, missiles, ID systems, radar warning receivers, electronic attack systems, missile launch detectors, and controls and displays will be procured, verified, and validated. The air combat threat models are being developed and will be validated by the NAIC.

Benefits

NAIC ATM will provide the F-22 test team credible tools to evaluate the lethality and survivability of F-22 weapon system against advanced threats. This capability will evaluate F-22 robustness in a dense threat environment and missions not covered in open air testing, support pilot training, and provide solutions for future DoD threat modeling. The JSF will also benefit and avoid starting an entire development process to have DIA-approved real-time models available for evaluation events.

Portable Joint Link-16 Monitoring Capability (PJLMC)

Defense Information Systems Agency Lead

Requirement

Escalating threats and rapidly advancing missile defense technologies have led the Ballistic Missile Defense Organization (BMDO) to assume responsibility for new programs, new research and development requirements and additional Joint Theater Air & Missile Defense (JTAMD) and National Missile Defense (NMD) system requirements. This has resulted in a requirement to test components operating within the JTAMD Family of Systems (FoS).

Description

PJLMC will provide a portable capability to monitor joint links that can be rapidly deployed to support network analysis and provide an interface to the TAMD analytical host. The system will provide real-time analysis of network and link activities, including time slot duty factors, packing density, network participation, group use, relay usage, and connectivity trend plotting. It will support adjudication of TAMD host issues through the association of network performance and anomalies. The Link Monitoring System (LMS-16) will give operators and net managers the ability to view network use of Joint Tactical Information Distribution System (JTIDS) / Multifunction Information Distribution System (MIDS) and monitor network activities, time slot duty factors, packing density, and Network Participation Group use. PJLMC will identify Link-16 transmission bottlenecks and unused capacity.

Benefits

PJLMC will provide cost-effective access to TAMD Battle Management Command, Control, Communications, Computers, and Intelligence, Joint Planning Network, Joint Data network, and Joint Composite Tracking Network components without requiring a Joint Tactical Information Distribution System (JTIDS) terminal. The system will be configured in a rapid deployment package, thereby reducing transportation costs when supporting operations in the field. It will provide an integrated network and TAMD analysis capability thereby increasing the efficiency and effectiveness of TAMD assessments and evaluations. The system will provide the ability to augment/associate JTAMD analysis with JTIDS network performance. PJLMC will provide near-real time feedback about Link-16 Network health and tactical display. The system will provide the ability to identify multiple and erroneous transmissions in dedicated time slots. PJLMC will support the testing of TAMD FoS, Navy Area/Navy Theater, and Patriot Advanced Capability-3.

SA-XX Modification (SA-XX Mod)

Navy Lead

Requirement

The SA-XX modification has been identified as a critical, near-term operational test requirement for the Radio Frequency Countermeasure (RFCM) portion of the Integrated Defensive Electronic Countermeasures (IDECM) Block III program. The RFCM requires test facilities capable of very accurate end-game measures of effectiveness against an advanced semi-active surface-to-air missile threat.

The SA-XX missile test capability was initially approved as an additional seeker asset for the Missile-on-the-Mountain (MOM) test resource, currently in operation at the Navy's Electronic Combat Range (ECR). After all attempts to acquire the required hardware had failed, the SA-XX funds for instrumentation and integration were returned to REP in FY99. This left a near-term shortfall regarding this high priority threat.

Description

The SA-XX Modification subproject will provide a critical, modern missile seeker test capability and provide a key threat simulator for the RFCM portion of the IDECM suite. By using existing hardware and updating the fly-out model, the Navy can simulate the SA-XX threat missile and fly-out characteristics in a realistic manner to meet the near-term shortfall. This approach will use the current threat documentation on the SA-XX missile seeker and the latest intelligence to enhance the ECR's open-air MOM as was intended by the previously approved REP program. This subproject will update the Flyout Model Information Center fly-out model and improve an existing stand-alone illuminator to be a more reliable and threat representative in the required frequency domain. This approach will allow insertion of actual hardware should this become available through Foreign Material Acquisition (FMA) channels. The fly-out model and illuminator are required regardless of whether an actual or surrogate seeker is used.

Benefits

The SA-XX Modification subproject will quickly and effectively meet the near-term shortfall, using a low risk approach. In addition, the capabilities developed under this program will also support the FMA Program when the actual hardware is delivered, thus reducing any further duplicative costs to the government. This asset will support testing of the IDECM Block III Follow-on, EA-6B Improved Capability III, and ALR-67(V)3 Advanced Special Receiver.

Theater Battle Management Core System (TBMCS) and Deliberate and Crisis Action Planning and Execution Segments (DCAPES) Command and Control Test Capability (TBMCS/DCAPES)

Air Force Lead

Requirement

A critical shortfall in the Command and Control Test Capability (C2TC) is putting the testing of DCAPES/ TBMCS at risk. Currently, there is no capability that could provide representative threat environments to support the operational testing of these systems. The only DCAPES laboratory in existence is not operationally representative, lacks access to the Secret Internet Protocol Router Network, and does not provide a secure operating environment. In addition, a requirement exists in TBMCS to support C2 environments as small as 50 workstations for a Wing Operations Center and up to 400 workstations for a Joint Air Operations Center.

Description

This subproject will fund the procurement of specialized computer hardware and data collection instrumentation needed to provide a C2TC. The C2TC is needed to support Combined developmental and operational testing beginning in FY01 for both DCAPES and TBMCS. The C2TC equipment will be integrated with the existing C2 infrastructure at Eglin AFB, FL to provide an operationally representative test environment to support near and long-term DCAPES and TBMCS testing. C2TC funding would provide servers and clients to achieve this capability, as well as provide a Tactical Receive System for TBMCS.

Benefits

This subproject will be used in the C2TC as the test operations center for both DCAPES and TBMCS during combined developmental and operational testing. This capability will evaluate how well DCAPES support deliberate and crisis action planning, plans execution, total asset visibility to sustain the force and operate in its intended environment, and how well TBMCS support Theater Air Campaign Planning and sustains Theater Air Operations. It will also evaluate the operational performance and suitability of DCAPES Spiral 1 and subsequent DCAPES increments and TBMCS version 1.02 and later. This subproject will support TBMCS to adequately test near-real-time intelligence applications for Wing/Squadron Operations Centers, thus decreasing the risk of software deficiencies in the situational awareness applications. The resulting command and control laboratory will also be used by Air Combat Command to refine their operations, tactics, and plan for the future.

XM-11S Priority Upgrades (XM-11S)

Army Lead

Requirement

The Army XM-11S threat simulators developed in the early 1980’s simulate a medium range, radar guided surface-to-air-missile system. It is currently the only test asset available to simulate this threat. Recently acquired documents that describe the threat have been machine translated, studied, and compared to the XM-11S, and major discrepancies were found. The current simulator design does not exhibit the correct response to electromagnetic countermeasures, nor does it provide the correct radiated emissions. Other XM-11S fidelity issues that have been identified include the medium-pulse-repetition frequency Doppler processor, the operator displays and controls, and the command, control, and communications interface and interaction with the command post.

Description

This subproject will rectify the priority deficiencies by adding a sidelobe compensation antenna, correcting the scan patterns, and adding a wide pulse width transmitted waveform. It will also replace the receiver and low pulse-repetition frequency processing, and the Digital Moving Target Indicator processing, and adding target identification processing.

Benefits

This subproject will provide the capability to correct fidelity deficiencies of the XM-11S simulator antenna, transmitter, and receiver subsystems. The upgrades will replicate the performance of the threat and enable the blue systems using the XM-11S to test in the most realistic operational environment possible. In the next three years, this system will support operational testing of the Suite of Radio Frequency Countermeasures, the All Service Combat Identification Team, the CV-22, the Joint Tactical-Unmanned Aerial Vehicle, and the Comanche.

Test Technology Development and Demonstration

- Automatic Target Identification Systems
- Common Event Network Test-Instrumentation Systems
- Fiber Optic Microwave Transmission System
- High Frequency Test Facility
- Hypersonic Scramjet Propulsion Test Technology
- Hypervelocity Wind Tunnel No. 9
- Multi-Band Antennas for Telemetry
- Open Architecture Plug-and-Play Participant Package
- Optical Data System for Transonic Wind Tunnel Testing
- Range G Hypervelocity
- Soft Impact Location Capability
- Virtual Flight Test Wind Tunnel Dynamics

NEW STARTS

- Miniature Optical Nodes for Environmental Testing
- Optical Characterization of Exoatmospheric Surface Effects
- Two-Way Robust Acquisition of Data

Test Technology Development and Demonstration (TTD&D) sub-projects are CTEIP investments in technologies that will reduce technical risk in testing for future weapon programs. There are two categories of TTD&D technologies: Range Instrumentation and Test and Range Architecture. Range Instrumentation and Test includes those technologies that provide improved test and evaluation instrumentation or process capabilities. Range Architecture include technologies that support the development of a common range architecture that can sustain test and training range interoperability through the use of standard interfaces. These interfaces will simplify asset sharing among the Services, lower the cost of testing, and facilitate economy-of-scale procurements, thereby lowering system upgrade costs.

For additional information contact Ms. Suzanne Strohl, the TTD&D Project Manager at (703) 578-8222, e-mail sstrohl@dote.osd.mil

Automatic Target Identification Systems (ATIDS)
Army Lead

Test and evaluation is becoming increasingly complex for National Missile Defense and Theater Missile Defense systems. Realistic operational, Family of Systems, and congressionally-mandated Many-on-Many tests will increase the difficulty of collecting metric and signature data needed to evaluate hit-point(s) and to develop discrimination algorithms. In addition, the difficulty in identifying high-priority targets will increase as the amount of targets, decoys, debris, chaff, and clutter in the test environment increases. A key component that will help ensure test requirements are satisfied is an automatic target identification system similar to those used in weapon systems such as the Theater High Altitude Area Defense and in surveillance and national intelligence systems. The ATIDS subproject will develop a modular automatic system to identify targets through combining various data from multiple sensors including telemetry, beacon and skin-tracking radars, optical sensors, and multiple object tracking radars. ATIDS will collect real-time metric and signature data from all targets in view by multiple sensors, associate and fuse the data, automatically identify targets, and display the situation for system operators. The ATIDS technology will address current operational needs and provide a test-bed for the development and demonstration of new real-time, multisensor identification and discrimination algorithms. This system will accommodate visiting sensors participating in range activities and thus facilitate interoperability between ranges and external assets in joint test exercises. The technologies selected for this project have potential application to many projects that involve automated decision-making based information from multiple sources. The applicability of these technologies extends to projects in such varied areas as sensor resource allocation, fire control, battlefield management, and quality control in manufacturing.

Common Event Network Test-Instrumentation Systems (CENTS)
Air Force Lead

The CENTS subproject takes power line networking, designed for home use in networking devices over standard electrical wiring and combines it with advanced test sensors to provide a quick reaction virtual network for data acquisition during airborne testing. The aircraft application being developed under CENTS will allow data collection of onboard test instrumentation signals and retransmit them over the aircraft electrical wiring to be recorded and/or retransmitted to the ground. The challenge of CENTS is to build a fast, reliable network to collect data that does not add more wiring to the already overcrowded electrical infrastructure of the aircraft. The solution is to provide both power and communications transmissions, simultaneously, over the same wire. The core of the CENTS virtual network is its use of commercial off-the-shelf (COTS) power line transceivers to establish a local area network (LAN) on the aircraft's AC and/or DC power busses. Current COTS technology allows the LAN to operate at a data transfer rate of around 14 megabits per second (Mbps) with rates of up to 50 Mbps projected in the near term.

Phase 1 exit criteria for CENTS was successfully demonstrated in FY00. The threshold data rate was 1 Mbps with a goal of 10 Mbps. A demonstration of the CENTS aircraft power bus networking technology was successfully conducted. The test demonstrated a 14 Mbps data transfer speed on the F-15 Eagle 115 VAC 400 Hz and 28 VDC Aircraft Power Busses with engines running. This speed allowed clear color video teleconferencing between two weapon stations using two computers on a MIL-STD-704E power bus. Phase 2 is underway in FY01 with demonstration of Cents Smart Instrumented Coupled Connectors (CSICC). A specific CSICC application (e.g. analog, digital, etc.) will be chosen for Phase 2 demonstration. This application will be representative of the type of data collection issues that will be encountered by the CSICC during normal use. The CSICC subsystem will be integrated with the capability developed under Phase 1 and demonstrated to operate within the integrated environment.

Fiber Optic Microwave Transmission System (FOMTS)
Navy Lead

Fiber-optic microwave transmission systems are needed by the all of the Services and other DoD customers. The applications range from accurately determining the electromagnetic compatibility of aircraft and other systems, to dramatically lowering the size and weight of, and improving the performance of antenna-to-receiver signal connections on both aircraft and other platforms. The FOMTS is a subproject will develop a point-to-point microwave transmission system that would replace coaxial cable with fiber-optic cable. The replacement system would offer lower loss over large distances. The project will investigate the integration of a radio frequency sensor at the input end to again lower the signal losses in the total system. The goal of the subproject is to provide a system that can be used in the test laboratories in conjunction with the measurement of microwave signals. The many advantages of fiber-optics in these applications include low system size and weight, extremely-broadband system RF response, and immunity to Electromagnetic Interference (EMI), including the ability to penetrate EMI shielding without compromising shielding integrity.

Three builds of fiber-optic microwave transmission systems are planned under the subproject: a general purpose laboratory grade fiber-optic link having a 50-ohm coaxial input at the transmitter end, to which a user's own measurement antennas can be connected for various monitoring/receiving purposes; a high performance single channel fiber-optic link with ultra compact transmitter and receiver at the ends for a one to one coaxial cable replacement; and a link with an integral, impedance-matched optical antenna that is superior for RF field measurements inside and around aircraft and other systems as well as for antenna remoting purposes. The subproject has completed the development of the laboratory grade fiber-optic link. Efforts have been concentrated on the development of this prototype system. The prototype has been successfully demonstrated, and evaluations of this link will be performed during FY01 to gain insight on the link with integral antenna. The high performance single channel fiber-optic link has concentrated its effort on fabrication of a Vertical Cavity Surface Emitting Laser (VCSEL), which will be integrated and used to test the link. The optical antenna is in the final design phase and will use either the VCSEL (from the single channel link) or a microwave quantum-well modulator.

High Frequency Test Facility (HFTF)

Defense Information Systems Agency Lead

The HFTF subproject will augment the existing high frequency testing capabilities at the Joint Interoperability Test Command (JITC). The augmentation of the test facility will result in an improved testing posture for emerging standards and technologies and will enhance JITC support to the warfighter, other Federal agencies, and foreign allies with up-to-date HF test and evaluation capabilities. The augmentation will be attained by the acquisition and installation of a three-level, System Capable of Planned Expansion (SCOPE), Command "Lights Out-capable," HF communications station. SCOPE Command was mandated by the Office of the Secretary of Defense as the joint, high power, fixed station HF system, and JITC acts as the Responsible Test Organization for the High Frequency Global Communications System Program Office (responsible for SCOPE Command). A series of feasibility evaluations involving automated link establishment, high-speed waveforms, and high frequency data link protocols will be conducted. HFTF will demonstrate the enhanced testing capabilities and validate the applicable HF communications military standards. The demonstrations will assess the feasibility of third generation automatic link establishment (ALE) in an operational setting with legacy equipment; determine the operational and functional feasibility of high-speed waveforms, as described in MIL-STD-188-110B and STANAG 5066; and demonstrate the feasibility of the HF data link protocol (MIL-STD-188-141B) within an operational network.

Hypersonic Scramjet Propulsion Test Technology

Air Force Lead

New hypersonic aeropropulsion systems are being developed by the Air Force, the Defense Advanced Research Projects Agency, and the Navy to support Long Range Strike and Affordable Access to Space systems. These aeropropulsion systems will require significant development time in ground-based test facilities. However, the testing of integrated scramjet propulsion systems is a complex process; testing of the entire system from the inlet tip to the exhaust nozzle exit is required. Because of this complexity, it is very important to understand the relationship between the ground-based test facility and the test article. A test facility capability of high fidelity, long duration test and evaluation of weapons system-sized scramjet propulsion systems is necessary to meet current requirements. The essential technology to be demonstrated by this effort will be a ground-based test and evaluation capability for the air breathing propulsion systems of fast-reaction weapon systems. The major activities of this subproject are driving towards a scramjet systems test in FY01. These activities include the development, demonstration, and validation of test methodologies, analysis techniques, and non-intrusive diagnostics to measure important performance-related parameters. Test methodologies will focus on vitiated test medium effects and facility operability. Analysis techniques will be developed to understand the facility operation and force accounting, based on scale force measurements in a free jet test environment. Non-intrusive diagnostics techniques will be developed to support data collection and to assess the operability of the scramjet system. Data exchanges with national and international partners will be used to identify gaps in capabilities and available solutions. Modeling and simulation of the test facility will be used to ensure successful facility operation while reducing the risk to the test article. The scramjet engine test program will take place in the Arnold Engineering Development Center Aerodynamic and Propulsion Test Unit. This hypersonic facility, along with the test methodologies, analysis techniques, and non-intrusive diagnostics developed under this subproject, will provide a sound foundation for the testing and evaluation of hypersonic missile systems.

Hypervelocity Wind Tunnel No. 9
Ballistic Missile Defense Organization Lead

Current Theater Missile Defense (TMD) interceptor programs require data on the influence of the hypersonic aero/thermodynamic environment of the kill vehicle on the optical performance of missile seekers to accurately predict probabilities of interceptor endgame kills. The goal of this subproject is to advance the aero-optical diagnostic capability of ground test facilities by developing an optical measurement system that can detail the aero-optical effects induced on a seeker system in a wind tunnel, thus reducing risks in flight tests. The Tunnel 9 Aero-Thermal-Structural Test Facility is the only wind tunnel in the U.S. that can simultaneously duplicate flight pressures, temperatures, and engagement times of TMD endgame scenarios. This facility produces the correct aero/thermal environment on full-scale flight hardware to accurately test and evaluate these optical effects. This subproject is a three-year effort to develop an optical measurement system to measure the total aero-optical and aero-thermal optical distortion error induced on seekers. The final phase of this project will demonstrate the measurement capability of this measurement suite by testing a generic, cooled-window interceptor geometry. A high-resolution sensor specifically designed to measure these distortions has been designed and procured. Sensor validation testing and facility integration has also been completed. In FY01, efforts will focus on the design and construction of a wind tunnel test article and associated support hardware that can be used in the demonstration experiment.

Multi-Band Antennas for Telemetry (MUBAT)
Army Lead

The goal of the MUBAT subproject is to improve and re-qualify existing software for the design of telemetry antennas and to build and flight test new multi-band antennas for telemetry on a wide variety of gun-launched projectiles and missiles. There is a critical need for the development and demonstration of multiple frequency band antennas for telemetry. Test and evaluation requirements in the tri-Service technical and operational test communities require telemetry antennas to simultaneously operate at multiple frequencies for data and command links such as S-band (telemetry) and at L-band (Global Positioning System (GPS) L1 and L2). The challenge is that very limited space is afforded, thus complicating the isolation of the signals. If multiple band antennas are not developed, then telemetry will be excluded from many technical and operational tests when the payload is included. This will significantly increase risk and require more tests and larger numbers of test munitions. A tri-Service team was established to address multiple band antennas, and this team has evaluated and used existing software with success. Major efforts will be made to develop smaller multi-band antennas for use on tactical configurations. A wide look, quadrafilar helix GPS L1/L2 antenna has been designed for improved performance. This antenna will be fabricated and ground tested with flight tests supported by the Air Force. Additionally, a commercially available, quadrafilar helix antenna has also been obtained (L1 only) for pattern measurements and comparison. Substantial progress has been achieved in S-band/GPS L1 dual band antennas and two designs have been built and ground tested. Amplifier-filter designs were also completed. One design supports the integration of GPS into an advanced missile instrumentation package, while the other is for a 5-inch missile. The focus of this subproject will now be to flight test designs of these types and to advance the designs to smaller surface areas.

Open Architecture Plug-and-Play Participant Package (P2 POD)
Air Force Lead

The goal of this subproject is to develop methodologies required to define and demonstrate the concept of an open architecture participant package and allow for easier and less costly placement of future technologies into existing systems. Additionally, this program is to provide a recommended interface standard between the major modules in the participant package. Based on commercial standards, the use of commercial off-the-shelf modules or components will be used. The benefit of this subproject will be the provision an open architecture Plug-and-Play Participant Package which will allow leveraging of commercial technology developments with minimum Research and Development cost to future developments for programs such as the Enhanced Range Application Program (EnRAP). This system will have the flexibility of day to day mission changes, by range personnel, of the major DOD test and training range instrumentation packages required to meet the varied range requirements.

Optical Data System for Transonic Wind Tunnel Testing (ODS)
Air Force Lead

The ODS subproject is developing an integrated optical diagnostics system for the Aerodynamics 16-foot transonic (16T) wind-tunnel testing area of the Arnold Engineering Development Center. This system will provide aerospace system developers and testers with the tools to reduce the total time required to conduct a wind-tunnel test program. Because the use of optical diagnostics allows data of particular parameters to be acquired without the need for an instrumented model, it enables testers to greatly reduce the time and cost required to design and construct wind-tunnel models. Associated cost reductions also include reduction of model assembly time at the test facility, elimination of model instrumentation setup time, significant reduction in tunnel set-up time, and the potential to combine multiple wind-tunnel tests into a single entry and test run. This subproject will also provide a capability for annotating the image data acquired by the Pressure Sensitive Paint system with test configuration details. An Optical Diagnostics Controller has already been implemented and interfaced to the Boundary Layer Transition and Laser Vapor Screen diagnostic systems. Operational and simultaneous control of these diagnostics through a fiber-optic reflective memory network has been achieved.

Range G Hypervelocity
Ballistic Missile Defense Organization Lead

Current Ballistic Missile Defense Organization programs such as the National Missile Defense system and future Theater Missile Defense programs require ground-based lethality testing at impact velocities in excess of ten kilometers per second. Launching projectiles (scaled interceptors) at these velocities requires improvements in projectile fidelity and launch techniques. The goal of this subproject is to develop methodologies required to upgrade the Arnold Engineering Development Center Range G Hypervelocity Ballistic Range Facility for impact/lethality testing at speeds up to 10 kilometers per second. This effort will include a thorough review of enhanced launch techniques to provide higher launch velocities of fragile projectiles. These techniques will be evaluated for their potential of meeting emerging test requirements and the level of investment required to make the upgrade or expand the current capability. Three concepts that had the potential to provide the desired launch capability were considered and the concept "Ultra High Pressure-High Pressure Section" was determined to have the highest probability of success. This concept uses a high-pressure section (HPS) capable of containing a pressure of up to 400,000 psia for sufficient time to allow accelerating a projectile to the desired speed. Some deterioration of the HPS is expected on each shot and the stress level in a small portion of the inner bore of the HPS will go beyond yield and possibly distort. Small-scale laboratory experiments using the Ultra High Pressure-High Pressure section concept was started in FY00 and will be completed in FY01. A recommendation and preliminary design for upgrading the G Range Facility will be provided at the end of FY01.

Soft Impact Location Capability (SILC)
Navy Lead

The Services are each developing families of precision munitions which are dependent upon internal guidance and control systems for their effectiveness. Testing such munitions requires their launch under actual conditions against appropriate targets, their location after impact, and in many cases a soft impact system to prevent their destruction from impact with hard targets. The Services have all recognized the need for a SILC. A candidate solution that meets the SILC requirement is to fire the weapons being tested from a land, sea, or air platform into a shallow water target area at sea. After impact with the sea surface, the munitions are rapidly decelerated and sink to the bottom where recovery can then be made by divers and/or marine mammals. The SILC subproject will establish the technical feasibility of a soft impact and location capability to support "smart" munitions testing. This subproject will also verify the capability of advanced signal processing and position location algorithms to accurately determine the point of impact for single munitions on the sea surface and the location and distribution pattern of multiple impacts on the sea surface in areas of shallow water. The SILC subproject will be developed in three phases. Phase 1, which is complete, consisted of the conducting of tests to collect empirical data for water impacts in shallow water. In phase 2, algorithms will be developed using a simulation model developed from the phase 1 empirical data. Phase 2 will be completed during FY01 and the first half of FY02. During phase 3, the phase 2 algorithms will be validated on a signal processing test bed, using simulated and empirical data. Phase 3 will be completed during FY03. The feasibility of acoustically scoring water impacts of weapons has been previously demonstrated on various deep-water ranges. An experiment several years ago at Wallops Island demonstrated that further algorithm development is needed to extend the deep-water algorithms for use in shallow water. The phases outlined above result in a validated algorithm for use in shallow water.

Virtual Flight Test Wind Tunnel Dynamics (VFT)
Air Force Lead

Recent efforts at the Arnold Engineering Development Center focused on the development and demonstration of a new wind tunnel test capability called Virtual Flight Testing (VFT). The new capability will provide aircraft and missile designers with a mechanism to evaluate and validate autopilot and flight-vehicle control system designs in a wind tunnel environment. The airframe, including the control devices and autopilot, can be mounted on a motion-enabling device. The motion-enabling device will allow free rotation of the VFT hardware in response to moments produced by control devices. It is hoped that the VFT methodology can bridge the gap between hardware in the loop testing, which is based on static wind tunnel testing, and open-air flight testing. In doing so, VFT can mitigate the risk of flight-testing, reduce the program development cycle time, and reduce cost of testing by reducing the number of test sorties required for weapon system development. The subproject is a multi-year effort that will culminate in a demonstration test of the VFT concept in FY01. In that year, efforts will focus on final preparation and execution of the VFT demonstration test. These efforts will include pre-flight simulations, instrumentation procurement, calibration and checkout of instrumentation, model hardware, and support system, and ground vibration tests. Finally, the data collected during the tests will be analyzed and a report will be prepared to present the results and conclusions from the demonstration.

New Starts

Miniature Optical Nodes for Environmental Testing (MONET)

Navy Lead

Military weapon systems are relying increasing more on modeling and simulation (M&S) as a means of supplementing, and in some cases, replacing physical environmental testing. The effectiveness of M&S in environmental testing is highly dependent upon the validity of the models, which in turn, is dependent upon the availability of test data for validation. Current test technology cannot provide adequate data to fully validate many physics based models, and as a result, the full benefits of M&S in environmental testing cannot be realized.

The MONET subproject will exploit the unique characteristics of fiber optic sensors to collect environmental test data from complex mechanical and polymeric materials. The optical sensors are extremely small, lightweight, and robust and are immune to electromagnetic interference. They operate on the basis of a Fabry-Perot interferometer, which gives them the capability of collecting strain, pressure, load, displacement, and temperature data on the system under test. The optical sensor can be employed in extreme environmental regimes where conventional sensors cannot be used, such as underwater, in exo-atmospheric regions, and in areas of high electro-magnetic interference.

Optical Characterization of Exoatmospheric Surface Effects

Air Force Lead

The goal of the Optical Characterization subproject, which includes a partnership with industry and academia, is to develop the capability to simulate low and medium earth orbit atmospheric effects on mini and micro satellites and satellite subsystems, structural components, and optical assemblies. Research laboratories can perform fundamental materials testing on samples, but there is no facility to test the integrated behavior of complex geometric assemblies in a realistic orbital simulator. This test shortfall has forced systems to be over-designed to account for surface erosion and contamination from natural and man-made environmental elements.

This new test capability will be installed in the 12V chamber at Arnold Air Force Base and will provide precise control of the flux and duration of atomic oxygen and solar and plume contamination. Additional capabilities include the improved measurement of spectral optical reflectance, spectral optical transmittance, spectral surface luminescence, molecular flow scattering angle, and the distribution of molecular flow scattering energy. The subproject will also develop a “facility model” that incorporates the sources, pumps, and hardware, which should result in maximized pumping capacity, minimal facility degradation, and test schedule optimization.

Two-Way Robust Acquisition of Data (2-RAD)

Ballistic Missile Defense Organization Lead

The coordination of test sequences and operations and the collection of data when simultaneously testing weapons platforms, vehicles, weapons systems, and munitions are burdensome and labor intensive. Internet-like, seamless, two-way communications can be used to break this bottleneck. The heart of this advance in technology will be Hardened Subminiature Telemetry and Sensor System (HSTSS) technologies developed under CTEIP. HSTSS developed a family of miniature and rugged, telemetry products and sensors for use on gun-launched projectiles and small missiles. HSTSS programmability and miniaturization can be used to implement rugged, low power two-way control and data communications using wireless local area network (LAN) and WEB chips operating at 2.4GHz (instead of standard telemetry at S-band). The 2-RAD subproject will demonstrate the feasibility of replacing the current data transmission infrastructures with internet-like devices. 2-RAD will take data from HSTSS-instrumented systems and sensors and provide a COTS-based connecting network to distribute data with a minimum cost. The HSTSS implementation will drive down size, cost, and power requirements, while increasing usage due package convenience and programmability.

2-RAD's network technology will greatly increase test range productivity with commensurate savings in terms of reduced infrastructure, reduced instrumentation costs, reduced manpower, and expedited test schedules. The same technology has the potential to revolutionize warfare on the battlefield. There is a pressing need for a two-way exchange of data between test items (trucks, howitzers, missiles, projectiles, etc) and range data acquisition/control assets.

Appendix A

CTEIP JIM Projects in Execution at the MRTFB

This section of the report maps Major Range and Test Facility Base (MRTFB) activities at which CTEIP JIM projects are currently in execution. The MRTFB consists of activities that provide and operate test facilities and ranges and make up a significant part of the DoD T&E infrastructure, and it supports developmental and operational testing for all major weapons acquisition programs and research activities at DoD and other Government Agencies. CTEIP projects are currently managed at ten MRTFB Activities, however, this number is expected to vary from year to year. MRTFB components are managed by the individual Military Services and Defense Agencies.

Appendix B

CTEIP JIM Projects Support Organizations and Technical Points of Contact

This section of the report provides a listing of government organizations and private companies that are actively engaged in support of the JIM Projects in CTEIP. The wide geographic, as well as functional, range of this listing serves to illustrate the depth and breadth of the developmental efforts funded by the CTEIP.

Project	Support Organization	Technical Point of Contact
AMOAS	**U.S. Army STRICOM** 12350 Research Parkway Orlando, FL 32826	Mr. Raymon Lozano White Sands Missile Range ATTN: WSTC-TT-TE Building 1506/NRD White Sands, NM 88002 (505) 678-3521 lozaron@wsmr.army.mil
	White Sands Missile Range White Sands, NM 88002	
	Lockheed Martin Government Electronics System 199 Bordon Landing Road Moorestown, NJ 08057	
	NewTec White Sands Missile Range White Sands, NM 88002	
ARTM	**Air Force Flight Test Center** 307 East Popson Avenue Edwards AFB, CA 93524	Mr. Patrick Feeley Air Force Flight Test Center 412th Test Wing 300 East Yeager Blvd Module 500 Edwards AFB, CA 93524 (661) 277-1608 Patrick.feeley@edwards.af.mil
	Naval Air Warfare Center **Aircraft Division** Code 513000A, Building 2118, MS 3 Patuxent River, MD 20670	
	Naval Air Warfare Center **Weapons Division** Code 543C00E, 521 9th Street Point Mugu, CA 93042	
	White Sands Missile Range ATTN: STEWS-IDD-SA White Sands, NM 88002	
	California Institute of Technology Jet Propulsion Lab 4800 Oak Drive Pasadena, CA 91109-8099	
	Herley-Vega 10 Industry Drive Lancaster, PA 17603	
	Johns Hopkins University Applied Physics Lab 11100 John Hopkins Road Laurel, MD 20723-6099	
	L-3 Communications Aydin Division 47Friends Lane Newtown, PA 18940	
	L-3 Communications Microdyne Division 491 Oak Road Ocala, FL 34472	
	Nova Engineering 5 Circle Freeway Cincinnati, OH 45246	
	RF Networks 10201 N. 21st Avenue, Unit 9 Phoenix, AZ 85021	
	Tybrin Corporation 1283 North Eglin Parkway Shalimar, FL 32579	

Project	Support Organization	Technical Point of Contact
AIT	**Air Force Flight Test Center** 418th FLTS/DOES 300 North Wolfe Building 1830A Edwards AFB, CA 93524	Mr. Saul Ortigoza 418th FLTS/DOES 300 North Wolfe Building 1830A Edwards AFB, CA 94524 (661) 277-0800 x 2614 Saul.ortigoza@edwards.af.mil
	Air Force Flight Test Center 412TW/LGI 25 North Wolfe Avenue Building 3950 Edwards AFB, CA 93524	
	Army Aviation Technical Center Building 5678 Room S-11 Redstone, AL 35898	
	Federal Aviation Administration William J. Hughs Center Atlantic City International Airport Atlantic City, NJ 08405	
	Naval Air Warfare Center – Aircraft Division Building 2187, Suite 2A04 48110 Shaw Road, Unit 5 Patuxent River, MD 20570	
	Sverdrup Technology, Inc. 1099 Avenue C Arnold AFB, TN 37389	
	Tybrin Corporation 307 E. Popson Avenue Building 1400 Edwards AFB, CA 93524	
BCEP	**Big Crow Program Office** 3710 Trestle Road Kirtland AFB, NM 87117	Mr. Milton Boutte US Army Space & Missile Defense Command 3710 Trestle Road Kirkland AFB, NM 87111-5000 (505) 846-8889 Milton.boutte@kirkland.af.mil
	Threat Simulator Management Office ATTN: AMPCOPM-ITTS-S Redstone Arsenal, AL 35758	
	Electronic Warfare Associates 13873 Park Center Drive Herndon, VA 22071	
	Syndetix, Inc. 2820 Telshor Blvd Las Cruces, NM 88011	
	Terradigm, Inc. 401 Alvarado SE Suite G Albuquerque, NM 87109	
	TMC Design 210 E. Idaho, Suite A Las Curces, NM 88005	

Project	Support Organization	Technical Point of Contact
DRTF-E	**Arnold Engineering & Development Center** 676 2nd Street Arnold AFB, TN 37389	Maj. Robert Mainger, USAF Defense Threat Reduction Agency 6801 Telegraph Road Alexandria, VA 22310 (703) 325-1117 robert.mainger@dtra.mil
	Defense Threat Reduction Agency 6801 Telegraph Road Alexandria, VA 22310	
	U.S. Army Space & Missile Defense Command Box 1500 Huntsville, AL 35807	
E3GS	**Naval Air Warfare Center Aircraft Division** 48202 Stanley Road, Unit 5 Patuxent River, MD 20670	Mr. Fred W. Heather Naval Air Warfare Center Aircraft Division 48202 Stanley Road, Unit 5 Building 144, Suite 3B Patuxent River, MD 20670 (301) 342-6975 heatherf@navair.navy.mil
	Continental Electronics Corporation 4212 Beckner Drive Dallas, TX 75227	
	Technology For Communications Int'l. 47300 Kato Road Freemont, CA 94538-7334 Sunnyvale, CA 94089	
	Veridian Engineering 22309 Exploration Drive Lexington Park, MD 20653-2001	
EMTTEF	**Eagle Systems Inc.** 22560 Epic Drive California, MD 20619	Mr. Ken Runyan Naval Air Warfare Center Aircraft Division 22709 McCauley Road Patuxent River, MD 20670 (301) 342-0504 runyankr@navair.navy.mil
	Naval Air Warfare Center - Aircraft Division 22709 McCauley Road Patuxent River, MD 20670	
FI 2010	**Air Armament Center** 102 West D. Avenue Eglin AFB, FL 32542	Mr. George Rumford ATTN: CSTE-DTC-WS-TT White Sands Missile Range White Sands, NM 88002 (505) 678-2836 rumford@dote.osd.mil
	Electronic Proving Ground ATTN: CSTE-DTC-WS-EP-IT Ft Huachuca, AZ 85613-7110	
	Naval Undersea Warfare Center 1176 Howell Street, Building 104 Newport, RI 02841-1708	
	Naval Air Warfare Center Aircraft Division 48150 Shaw Road, Unit 5, Building 2109 Suite N228 Patuxent River, MD 20670-1183	
	Redstone Technical Test Center Building 7818 Redstone, AL 35898	
	U.S. Army STRICOM 12350 Research Parkway Orlando, FL 32826-3276	

<table>
<tr><th>Project</th><th>Support Organization</th><th>Technical Point of Contact</th></tr>
<tr><td rowspan="17">FI 2010
(continued)</td><td>White Sands Missile Range
ATTN: STEWS-NR-D
Building 1506
White Sands, NM 88002</td><td rowspan="17">Mr. George Rumford
ATTN: CSTE-DTC-WS-TT
White Sands Missile Range
White Sands, NM 88002
(505) 678-2836
rumford@dote.osd.mil</td></tr>
<tr><td>Aegis Technologies Group
Box 67307
Albuquerque, NM 87193</td></tr>
<tr><td>Aquidneck Management Associates
28 Jacome Way
Newport, RI 02840</td></tr>
<tr><td>AMTEC Corporation
500 Wynn Drive, Suite 314
Huntsville, AL 35815</td></tr>
<tr><td>Arthur D. Little
Acorn Park
Cambridge, MA 02140</td></tr>
<tr><td>BAE Systems Technical Service
Box 1898
Eglin AFB, FL 32542</td></tr>
<tr><td>DynCorp
21841-B Three Notch Road
Lexington Park, MD 20653</td></tr>
<tr><td>DynCorp
221 3rd Street
Newport, RI 02840</td></tr>
<tr><td>Inter Image Inc.
3030 Clarendon Blvd, Suite 380
Arlington, VA 22201</td></tr>
<tr><td>Logicon Information Systems
55 John Clark Road
Middletown, RI 02842</td></tr>
<tr><td>NCI Information Technologies
Building 1504, Suite 100
White Sands, NM 88002-0427</td></tr>
<tr><td>SAIC
5400 Shawnee Drive, Suite 110
Alexandra, VA 22312</td></tr>
<tr><td>SAIC
349 West Commercial Street, Suite 3030
E. Rochester, NY 14445</td></tr>
<tr><td>Software Engineering Institute
Carnegie Mellon University
5000 Forbes Avenue
Pittsburgh, PA 15213</td></tr>
<tr><td>Technologies Engineering
877 Baltimore & Annapolis Blvd, Suite 207
Severna Park, MD 21146</td></tr>
<tr><td>United Defense Limited Partnership
12461 Research Parkway, Suite 500
Orlando, FL 32836</td></tr>
<tr><td>Veridian Engineering
22309 Exploration Drive
Lexington Park, MD 20653</td></tr>
</table>

Project	Support Organization	Technical Point of Contact
HSTSS	**46th Test Wing** Air Armament Center 205 W D Avenue Eglin AFB, FL 32542-6865	Mr. Dennis Schneider U.S. Army STRICOM 12350 Research Parkway Orlando, FL 32826 407-384-3902 Dennis_Schneider@stricom. army.mil
	Redstone Technical Test Center STERT-TE-F-TD Building 7855 Redstone Arsenal, AL 35898-8052	
	U.S. Army Research & Development Command Picatinny Arsenal, NJ 07806-5000	
	Eagle Picture Batteries 1155 West 15th Street North Vancouver, CA V7P1M7	
	Emhiser Research, Inc. 2705 Old Highway 40 West Verdi, NV 89439	
	Haigh-Farr, Inc. 12 Industrial Way Salem, NH 03079	
	John Hopkins University Applied Physics Lab John Hopkins Road Laurel, MD 92858	
	MA/Com, Inc. 1011 Pawtucket Blvd. Lowell, MA 01853	
	Microelectronics & Computer Tech Corp. 3500 W. Balcones Center Drive Austin, TX 78759	
	Pathus (UK) Ltd. Mansard Close, Westgate Estate North Hampton, UK MN55DL	
	STATEK Corp 512 N. Maine Street Orange, CA 92868	
	Systems & Processes Engineering Corp. 101 West 6th Street, Suite 200 Austin, TX 78701	
	Ultralife Batteries, Inc. 1350 Route 88 South Newark, NJ 14531	
HHSTT	**846th Test Squadron** 1521 Test Track Road Holloman AFB, NM 88330	Mr. Dave Minto 846th Test Group 1521 Test Track Road Holloman AFB Holloman, NM 88330 (505) 679-2133 David.minto@.46tg.af.mil
	Redstone Technical Test Center ATTN: STERT-TE Redstone Arsenal, AL 35898	
	U.S. Army Aviation and Missile Command Propolusion Directorate ATTN: AMSAM-RD-PS-E Redstone Arsenal, AL 35898	

Project	Support Organization	Technical Point of Contact
HHSTT (continued)	**Atlantic Research** 5945 Wellington Road Gainesville, VA 20155	
	MTI, Inc. P.O. Box 4673 Ruidoso, NM 88345	
JAMI	**Naval Air Systems Command** PMA-280 47123 Buse Road, Unit IPT Patuxent River, MD 20670	Mr. Donald Scofield Naval Air Warfare Center Weapons Division Code 54A000D China Lake, CA 93555 (760) 939-1303 scofileddl@navair.navy.mil
	Raytheon Missiles Systems 1151 East Hermans Road Box 11337 Tucson, AZ 85734	
JISTF	**Air Armament Center** 101 West Eglin Blvd Eglin AFB, FL 32542	Mr. Richard Pegg Naval Air Warfare Center Aircraft Division Building 2109, Code 5.1 48150 Shaw Road Patuxent River, MD 20670 (301) 342-6019 peggrw@navair.navy.mil
	Air Force Flight Test Center ASFTC 1 Rosamond Blvd Edwards AFB, CA 93524	
	Naval Air Warfare Center **Aircraft Division** 22541 Millstone Road Patuxent River, MD 20670	
	Naval Air Warfare Center Weapons Division 1 Administration Circle China Lake, CA 93555	
	U.S. Army Missile Command Redstone Arsenal Huntsville, AL 35898-5239	
	Complek-Amherst Systems 495 Aero Drive Cheekpowaga, NY 14225	
	Complek-Amherst Systems 43865 Airport View Drive Hollywood, MD 20636	
	Mission Research Corp. 735 State Street Santa Barbara, CA 93102-0719	
	SPARTA, Inc. 4901 Corporate Drive Huntsville, AL 35805	
	ViaSat, Inc. 2290 Cosmos Court Carlsbad, CA 92009-1517	

Project	Support Organization	Technical Point of Contact
JMASS	**Missile and Space Intelligence Center** Building 4500 Redstone Arsenal, AL 35898	Mr. David McFarland ASC/SMJ 2145 Monahan Way Wright Patterson AFB, OH 45424 (937) 255-3969 x 3571 Dave.mcfarland@wpafb.af.mil
	Naval Air Warfare Center Weapons Division 1 Administration Circle China Lake, CA 93555	
	U.S. Air Force Research Lab 29 Randolph Road Hanscom AFB, MA 01731	
	U.S. Army Aviation and Missile Command ATTN: AMSAM-RD-SS-SD Building 5400 Redstone Arsenal, AL 35898	
	U.S. Army Space and Missile Defense Command P.O. Box Box 1500 Huntsville, AL 35807	
	Applied Data Trends, Inc. P.O. Box 1368 Madison, AL 35758	
	Beacon High Technology Resources 7906 Seville Huntsville, AL 35805	
	Georgia Tech Research Institute Harry L. Baker Building 925 Dalney Street Atlanta, GA 30332	
	Military Technology, Inc. 6767 Old Madison Pike Suites 200, 270, and 310 Huntsville, AL	
	Nichols Research Corp. 4040 South Memorial Parkway Huntsville, AL 35802	
	Simulation Technologies, Inc. 3307 Bob Wallace Avenue Suite 3 Hunstville, AL 35805	
	Spectral Sciences, Inc. 99 South Bedford Street Suite 7 Burlington, MA 01803	
LSVTC	**Naval Undersea Warfare Center** Code 74, Building 104 1176 Howell Street Newport, RI 02841	Mr. Sidney Steelman Aberdeen Test Center ATTN: CSTE-DTC-AT-SL Aberdeen, MD 21078 (410) 278-5140 ssteelma@atc.army.mil
	U.S. Army Aberdeen Test Center ATT: CSTE-DTC-AT-SL-B Aberdeen Test Center Aberdeen, MD 21005	
	Arthur D. Little Acorn Park Cambridge, MA 02140	

Project	Support Organization	Technical Point of Contact
LSVTC (continued)	**GTA** 3445A Box Hill Corporate Center Drive Abington, MD 21015	
	Logicon Information Systems 55 John Clark Road Middletown, RI 02842	
	MTS 14000 Technology Drive Eden Prairie, NM 55344	
	Sakonnet Technology Group 305 Church Pond Drive Tiverton, RI	
MSTCS	**Air Force Air Armament Center** 46th TW/TSS 303 Noth 7th Street, Suite 101 Eglin AFB, FL 32542-5429	Mr. William Holley 46TW/TSS 303 North 7th Street Eglin AFB, FL 32542 (850) 882-2478 holleyw@eglin.af.mil
	Naval Air Warfare Center **Weapons Division** Code 539100E 521 9th Street, Building 521, Room 221 Pt Mugu, CA 93042	
	White Sands Missile Range ATTN: STEWS-NRD-SG Headquarters Avenue, Building 1506 White Sands, NM 88002	
RWS	**U.S. Army Aberdeen Test Center** International Imaging Center Aberdeen Proving Ground Aberdeen, MD 21005-5059	Mr. Gregory Schultz Aberdeen Test Center ATTN: STEAC-AC-I Aberdeen, MD 21005 (410) 278-3510 gschultz@atc.army.mil
	U.S. Army STRICOM ATT: AMSTRI-RF-E 12350 Research Parkway Orlando, FL 32826-3276	
	U.S. Army Test & Evaluation Command ATTN: AMSTE-TM-T Aberdeen Proving Ground Aberdeen, MD 21006	
	U.S. Marine Corps Systems Command 2033 Barnett Avenue Suite 215 Quantico, VA 22314	
	Wright Patterson AFB Next Generation Small Loader Program Office Wright Patterson AFB, OH 45433	
	Arthur D. Little 20 Ground Pine Path Elkton, MD 31921	
	ESI Engineering Three Paramount Plaza, 7831 Glenroy Road, Suite 340 Minneapolis, MN 55439	

Project	Support Organization	Technical Point of Contact
RWS (continued)	**KCI Technologies** 10 North Park Drive Hunt Valley, MD 21030-1846	
	Lundquist, Killeen, Potvin & Bender 1935 W. Country Road, Building 2 St Paul, MN 55113-2722	
	MTS System Corp Advanced Engineering 14000 Technology Drive Eden Prairie, MN 55344	
	United Defense Limited Partnership 12461 Research Parkway Suite 500 Orlando, FL 32826	
	University of Maryland Center for Automotive Research Department of Mechanical Engineering College Park, MD 20742	
	Vogt Architectural Services, LLC 9000 Old Cedar Avenue Bloomington, MN 55425	
TRACS	**White Sands Missile Range** White Sands, NM 88002	Mr. Humberto Royo White Sands Missile Range ATTN: WSTC-TT-TE Building 1506 White Sands, NM (505) 678-2916 royoh@adam.wsmr.army.mil
	EMI Technologies 2200 N. Telshor Blvd Las Cruces, NM 88011	
	NewTec Corporation White Sands Missile Range White Sands, NM 88002	
TSMADS	**Aberdeen Test Center** ATTN: STEAC-SF-A Aberdeen Proving Ground Aberdeen, MD 21002	Mr. Rusty Bauldree Air Armament Center/46TW 303 N. 7th Strret, Suite 128 Eglin AFB, FL 32542 (850) 882-5602 bauldree@eglin.af.mil
	Air Armament Center 303 N. 7th Street Eglin AFB, FL 32542	
	Arnold Engineering and Development Center MS 4300 Arnold AFB, TN 37389	
	Naval Undersea Warfare Center 1176 Howell Street Newport, RI 02841	
	Naval Air Warfare Center Aircraft Division Building 1406, Unit 4 Patuxent River, MD 20670	
	Naval Air Warfare Center Weapons Division Code 454340E Pt. Mugu, CA 93042	
	Bomen, Inc. 450 Saint Jean-Baptise Avenue Quebec, Quebec G2E 5S5 Canada	

TSMADS (continued)	**Marconi Aerospace Systems** 115 Bay State Drive Birmingham, AL 02184	
	Pender Technologies 61 Gibson Lane Decherd, TN 37240	
	SAIC 10260 Campus Point Drive San Diego, CA 92121	
	Southern Research Institute 757 Tom Martin Drive Birmingham, AL 35222	
	NEW STARTS	
AIDACS	**Headquarters Air Force Material** Command/DOX 4225 Logistics Avenue Suite 2 Wright Patterson AFB, OH 45433-5440	Mr. Saeed Zadeh Arnold Engineering Development Center Tullahoma, TN 37389 (631) 454-7790 Saeed.zadeh@arnold.af.mil
DVL	**Air Armament Center** 101 West Eglin Blvd Eglin AFB, FL 32542	Dr. Cliff Alexander Air Armament Center/46TW 205 West D Avenue, Suite 348 Eglin AFB, FL 32542 (850) 882-9811 Cliff.Alexander@eglin.af.mil
	Naval Air Warfare Center - Aircraft Division 23029 Cedar Point Rd Patuxent River, MD 20670	
	Army Aviation Engineering Directorate Engineering Directorate Redstone Arsenal, AL 35898	
	Sarnoff Corporation 201 Washington Road CN5300 Princeton, NJ 08543-5300	
GPS-SV	**SAIC** 303 N. 7th Street Suite 106 Eglin AFB, FL 32542-5641	Capt. Brian Bracy, USAF 746th Test Squadron 1644 Vandergrift Street Holloman AFB, NM 88330 (505) 679-2666 Brian.bracy@46tg.af.mil
JC4ISR	**Electronic Proving Ground** Attn: CSTE-DTC-WS-EP-TT Fort Huachuca, AZ 85613-7110	Mr. Rob Heilman Naval Air Warfare Center Weapons Division Code 5C0000E Point Mugu, CA 93042-5049 (805) 989-3276 Heilmanrg@navair.navy.mil
	Joint Interoperability Test Command ATTN: FMO Building 57305 Ft Huachuca, AZ 85623-7020	
	Naval Air Warfare Center – Aircraft Division Atlantic Ranges & Facilities 516200A Building 2109 Suite 115 48150 Shaw Rd. Unit 5 Patuxent River, MD 20670-1907	
	Naval Air Warfare Center – Weapons Division 575 I Ave. Suite 1 Point Mugu, CA 93042-5049	
	Naval Undersea Warfare Center - Division Newport 1176 Howell Street Newport, RI 02841-5047	
	Space & Naval Warfare Systems Command 4297 Pacific Highway San Diego, CA, 92110	

<table>
<tr><th colspan="3">NEW STARTS (CONTINUED)</th></tr>
<tr><td rowspan="4">MRO</td><td>New Mexico Highlands University
Department of Physics
Science Building
Las Vega, NM 87701</td><td rowspan="4">Mr. Tom Hamilton
SMDC Radar/Ladar Division
P.O. Box 1500
ATTN: SMDC-TC-TD-SR
Huntsville, AL 35807-3801
(256) 955-4570
Tom.Hamilton@smdc.army.mil</td></tr>
<tr><td>New Mexico Institute of Mining and Technology
Department of Physics
New Mexico Tech
Socorro, NM 87801</td></tr>
<tr><td>New Mexico State University
P.O. Box 30001
MSC 4500
Department of Astronomy
Las Cruces, NM 88003</td></tr>
<tr><td>University of Puerto Rico
Department of Physics
Mayaguez Campus
San Juan, Puerto Rico 00680-9016</td></tr>
<tr><td rowspan="3">SS2</td><td>White Sands Missile Range
CSTE-DTC-WS-NRO
Building 1530
White Sands, NM 88002</td><td rowspan="3">Mr. Ernest Balizan
White Sands Missile Range
CSTE-DTC-WS-TT-SS
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(505) 678-4947
Balizane@wsmr.army.mil</td></tr>
<tr><td>White Sands Missile Range
CSTE-DTC-WS-IO
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White Sands, NM 88002</td></tr>
<tr><td>White Sands Missile Range
AMSRL-SL-EA
Building 1649
White Sands, NM 88002</td></tr>
</table>